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2. The MS. should be typed (double spacing) on one side of a sheet only, and the sheets properly numbered.

3. All scientific names to be printed in italics should be underlined.

4. Trinomials referring to subspecies should only be used where identification has been authentically established by comparison of specimens actually collected.

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6. Text-figures, line drawings, and maps should be in Indian ink, preferably on Bristol board.

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8. Reference to literature in the text should be made by quoting the author's name and year of publication, thus: (Banerji 1958).

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Reconsideration of *Athene blewitti* (Hume)[1]

S. Dillon Ripley

(*With a plate*)

A visit to northern and western Orissa in February, 1975, by Dr. Sálim Ali, my wife and myself was undertaken partly to ascertain the whereabouts of *Athene blewitti*, the enigmatic species of forest owlet, not recorded since Meinertzhagen collected a specimen in October, 1914 near Mandvi on the Tapti River northeast of Bombay.[2] The species has been recorded from there east to Sambalpur, Orissa, and the offer of hospitality and assistance from Shri Saroj Choudhury, Conservator of Forests for Wildlife of Orissa, propmpted us to commence our search at the eastern end of the range, nearer the original type locality of Busnah, Phooljan State (near Padampur, about 50 miles west of the bend of the Mahanadi River *circa* 21°N Lat., 83°E Long.). Although we worked the forested areas of the adjacent Mahanadi River carefully, using tape recordings of owl species to elicit calls at dusk and in the evening, we produced no evidence of the presence of *blewitti*.

In our search for owls in Orissa we were much aided by having put together a tape of owl calls provided through the generosity of the Cornell Laboratory of Bird Sounds, Dr. James L. Gulledge, Dr. Joe T. Marshall of Bangkok, the Edward Grey Institute and Dr. Claude Chappuis from Rouen. These owl calls were mostly of *Athene brama*, but included some

[1] Accepted July 1975.

[2] At my request Shri S. A. Hussain of the B.N.H.S. staff visited Mandvi April 19-21, 1976. No trace of the former heavy forest recorded years ago was to be found, but there is a small undulating terrain of thin forest surrounded by cultivation about 4 km east of the town.. Farther east and northeast there are patches of forest, which may well deserve more exploration. Heavy exploitation for timber and firewood continues. Only *Athene brama* was observed near the thin patch of forest. A short but intensive ten day visit to the Melghat Tiger Reserve area in near by Maharashtra in February, 1976 by Dr. Sálim Ali and party and myself revealed similar conditions and no evidence so far of the presence of *Athene blewitti*.

additional calls of *Bubo* and *Otus*. The chattering, cackling taped calls of *Athene brama* proved highly effective in decoying specimens of that owlet out of their perches and into the neighbourhood of our flashlights, so that we were able easily to see the birds as they flew back and forth over our heads and perched on nearby trees. The recorded owl calls were far more effective in eliciting response by the latter part of the month of February than they had been in the beginning, thus correlating with the onset of display prior to the breeding season. In the case of other species we were unable to decoy the birds towards us. We did hear calls of *Bubo coromandus, Glaucidium radiatum* and one or more unidentified *Bubo* as well as *Athene brama*. No curious or unidentified *Athene* calls were heard which might give an indication of the calls of *Athene blewitti*. Thus there is no information on the vocalization of Blewitt's Owl.

On my return to the United States I borrowed five of the half dozen known specimens of *Athene blewitti* for comparison with a small series of *Athene brama indica*. I am grateful to Dr. Snow of the British Museum (Natural History), Dr. Paynter of the Museum of Comparative Zoology, Harvard, and Dr. Lester Short of the American Museum of Natural History for the loan of these specimens.

These birds are largely unspotted on the crown above and between the white supraocular aspects of the facial disk. Small subterminal single flecks of dull white appear scattered on individual feathers, on the shaft of the feather itself, while in *brama* these spots are numerous, subterminal also, but bifid, lying on either side of the darker area of the feathers which includes the shaft.

The pale nuchal collar is reduced in *blewitti*, barely visible as scattered subterminal whitish spots in one specimen. Spotting is reduced on the scapulars and back which produces a plain, uniform darker grayish-olive-brown appearance, in contrast to the grayish-olive-brown interspersed with many pairs of subterminal spots of *indica*. The white spots on the primaries and secondaries are in general remarkably similar and give the same effect in both species. In contrast the white tail stripes are broader and more noticeable in *blewitti* (more than 5 millimetres in width, versus less than 5 mm in width and sometimes discontinuous in *brama*).

Below *brama* appears less banded with dark olive-brown on the collar below the throat, the band broken centrally, while in *blewitti* the band is noticeable, concolorous and continuous across the throat. Below this collar in both species there is a white central patch on the lower throat and upper chest followed by a broad patch of dark olive-brown which is only lightly striped with white subterminally, and meets in the centre of the chest. In *brama* this is less well defined, heavily barred with subterminal white bars, and merges gradually into the irregular olive-brown barring of the thighs and stomach. In *blewitti* the heavy dark olive-brown barring appears to be more confined to the flanks, leaving a clear patch of white in the centre of the stomach, lower flanks and thigh coverts.

In our Museum Diagnosis (1969, HANDBOOK BIRDS OF INDIA AND PAKISTAN, *3*, p. 303), Dr. Sálim Ali and I speak of the wing formula of *blewitti* as given in the various earlier texts, i.e. 3rd or 4th primary longest or the two subequal; 1st primary (from the outside) = 8th or a little shorter.

Comparing the five specimens examined, I find that each specimen differs slightly from the above, as follows:

(1) *Male* (BM Reg. No. 1965 M 5230); 3rd and 4th primaries, counting from

Athene brama
Spotted Owlet

Athene blewitti
Forest Spotted Owlet

outside, *or,* 7th and 8th primaries counting in the more modern fashion from the *inside* of the wing, are equal in length. First primary (from the outside) = shorter than 8th, *or,* counting from the *inside,* 10th (or outer visible primary) shorter than 3rd, i.e. between 2nd and 3rd in length.

(2) *Female* (MCZ, Harvard, No. 236630); 3rd and 4th primaries, counting from the outside, *or,* 7th and 8th primaries counting from the *inside* of the wing, are equal in length. First primary (from the outside) = 7th in length, *or,* counting from the *inside* 10th (or outer visible primary) = 4th.

(3) *Male* (Amer. Mus. Nat. Hist. N.Y. No. 265227); 3rd primary slightly longer than 4th, *or,* counting from the *inside* of the wing, 8th slightly longer than 7th. First primary about as long as 7th, *or,* counting from the *inside* of the wing, 4th about equal to the 10th.

(4) *Female* (BM Reg. No. 86. 2. 1. 544); this immature specimen is not suitable for primary measurements but suffice it to say that the 3rd primary is slightly longer than the 4th, *or,* counting from the *inside* of the wing, the 8th is slightly longer than the 7th.

(5) *Male* (BM Reg. No. 86. 2. 1. 546); 3rd primary slightly longer than 4th, *or,* counting from the *inside* of the wing, 8th slightly longer than 7th. First primary (from the outside) = shorter than 8th, *or,* counting from the *inside,* 10th (or outer visible primary) shorter than 3rd in length.

In the case of specimens of *A. brama indica* examined, the 3rd primary (counting from the outside), *or,* the 8th counting from the inside of the wing, tends to be slightly longer than the 4th, *or,* as the more modern terminology would have it, the 7th. In the same way the 1st primary (counting from the outside), tends to lie between the 6th and 7th in length, *or,* counting from the inside of the wing, the 10th tends to lie between the 4th and 5th. The net effect of this difference is to make the wing of *brama indica* more pointed, the wing of *blewitti* more rounded. Thus it appears from the examination of these specimens of *blewitti* that this population would seem to be a more sedentary one, although there is no indication that *brama indica* itself is migratory. Perhaps then *blewitti,* as noted, is a sedentary forest-

Specimen	Wing	Tail	Culmen (from cere)	Tarsus	Middle toe (without claw)
blewitti					
♂ Mandvi, Tapti R.	150	72.5	15	35	23
♀ Kandesh	148	70	15.5	37	21
♂ Khandeish	154	72	14	34	20
♀ (im.) Khandeish	147.5	63	16	34.5	21
♂ Khandeish	145	68	15	33	20
brama indica					
♂ Orissa	159	75	14.5	32	16.5
♀ Orissa	160	78	14	31	18
♀ Kathmandu, Nepal	161	77	14	30	17.5
♀ Kathmandu, Nepal	165	83	14.5	32	18

inhabiting species found in patches of tropical moist deciduous and subtropical wet forest along the foothills of the Satpuras from about E. Long. 73°30′, to E. Long. 84° plus, and between N. Lat. 21° and 22°.

Measurements of these birds clearly show that *blewitti* does not overlap *brama indica*:

From the above measurements it can be seen that *blewitti* has a shorter wing and tail proportionately, but slightly larger bill, longer tarsus and more massive feet. Additionally, the occiput appears larger in the available skins. A crude measurement of the skull, measured roughly across the frontals between the orbital sockets shows the *blewitti* specimens to be more than 30 millimetres, while the specimens of *brama indica* measure less than 30 mm in width.

To review the Key published in Dr. Sálim Ali's and my HANDBOOK (1969, Vol. 3, p. 297), it would seem advisable to point out the more precise differences between *brama* and *blewitti* and amend it as follows:

B Abdomen transversely barred 1

1 Crown distinctly spotted; back widely interspersed with subterminal spots; tail narrowly banded with white, less than 5 mm in width; collar band broken below, white throat patch smaller; first primary longer than sixth; skull and feet smaller .... *A. brama*

Crown unspotted or faintly spotted on the feather shafts; back plain, much reduced spotting; tail broadly banded with white, more than 5 mm in width; collar band continuous, white throat patch larger extending to centre of abdomen; first primary equals seventh or shorter than eighth; skull and feet more massive .... *A. blewitti*

In conclusion *blewitti* can be said to be an enigmatic species, co-occurring within the range of *brama indica*, in mid-continental India, presumably adapted to a different ecological niche in forest rather than farmland edges, and now to be classed as very rare.[1]

[1] In a recent publication, *Owls of the World* (J. A. Burton, Ed., New York: Dutton. 1973), there is a colour photograph on page 168, attributed to *Athene blewitti*. I have written to the gentlemen who took the photograph, Messrs. Gérard and Albert Grandjean of Geneva, Switzerland, who in their reply (pers. comm.) note that the bird was uniformly darker in appearance than *Athene brama* without visible spotting on the head, and that it presented a more lively and wilder appearance than *brama*, more like the barred forest owlet, *Glaucidium radiatum*. The locality was a jungle clearing near Nagpur (M.S.) in 1968. From the photograph, certain identification of this bird as *A. blewitti* is difficult, but the locality is certainly within the probable range for the species.

Identification of hairs of some Indian Mammals[1]

B. R. KOPPIKAR[2] AND J. H. SABNIS[3]

(*With* 21 *text-figures*)

A system for rapidly identifying hair specimens by means of structural patterns is outlined. A series of camera lucida diagrams depicting the structure of hairs from 21 species of mammals is presented. This facilitates identification by permitting a direct visual comparison with the structure of an unknown hair specimen. Comments on distinguishing features that may be useful for macroscopic recognition of hairs from the various species are also included.

INTRODUCTION

The Project Tiger in Maharashtra was intiated in the Melghat Tiger Reserve on 22nd February, 1974 with the main object of protecting and conserving the tiger. One important aspect of study which relates to the tiger is to know its food habits. In nature it is very difficult to keep track of all the animals killed by the tiger and an important method of knowing the food habits is through collection of faeces containing hair which will reveal the animals preyed upon by the tiger. The need for studying food habits of Carnivora in general and of the tiger in particular prompted us to undertake a study of mammalian hair structure that could be used for investigating food habits on the basis of hair remains in the faeces.

The present work involves the study of the actual hair. The animals investigated so far do not cover a complete list of mammals of Maharashtra or of the Project Tiger area. However, the study will be continued on other species of mammals depending on the availability of authentic hair specimens.

The practical applications of hair identification in biological and forensic sciences have been enumerated by several investigators (Mathiak 1938; Williams 1938; Mayer 1952; Adorjan & Kolenosky 1969). Some of the uses cited most frequently involve food habit studies, identity of a predator in cases of predation and the identity of a mammal inhabiting a den or a tree. Hair remains also serve as evidence in convicting a game law violator or determination of the authenticity of a fur coat.

The history of hair identification can be traced back to McMurtrie (1886) who studied different patterns of the cuticular surface of animal hair. Hausman (1920, 1924 & 1930) made drawings of different mammalian hairs which were of great taxonomic importance. The purpose of this investigation is to provide a set of illustrations of the structural pattern of mammalian hairs that can be used to make rapid visual comparison with unknown hair samples. This will eliminate the necessity of preparing and examining several known hair specimens each time an identification is to be made. A brief written description of the major

[1] Accepted March 1975

[2] Project Tiger, Melghat, Paratwada.

[3] Department of Zoology, Vidarbha Mahavidyalaya, Amravati.

macroscopic and microscopic distinguishing characteristics of the hairs of each species is given along with drawings.

Material and Methods

Initially, all hair specimens were carefully washed in hot water. They were air dried thoroughly and passed through ether and xylol. Hair slides were prepared in Canada-balsam. Camera lucida drawings were prepared of each hair showing cuticular and medullar pattern. The three basic regions of each hair fibre namely proximal, medial and distal were studied. The diagrams on the left hand side in the plates show the structure of hairs of the proximal end, in the middle the medial and on the right the distal end. In cases where the structure of proximal and medial portions of hair was identical, only one diagram was drawn representing both. The measurements given are averages.

Observations

The structural parts of a hair are the cuticle, cortex, medulla, pigment and hair cells. In the system of hair identification to be outlined only cuticle and medulla are important.

Indian Pangolin *Manis pentadactyla*
Fig. 1

Gross Appearance:

Length 2.4 cm. Colour milky white. Hair stems harsh and rigid with a diameter of 126 μ at the proximal end. Stems slightly curved.

Microscopic Appearance:

Hair border plain with small spines distributed all over. Medulla is visible only at the proximal region but not in the medial and distal regions.

Rhesus Macaque *Macaca mulatta*
Fig. 2

Gross Appearance:

Length 1.6 cm. Colour dusky gray. The hair measures 38 μ in diameter at the proximal end. Proximal and distal regions have fragmented medulla while the medial region has discoidal type.

Microscopic Appearance:

The hairs appear without scales. The hair pigment punctated or threadlike and is seen in the medial and distal regions of the hair; the proximal region lacks pigment.

Langur *Presbytis entellus*
Fig. 3

Gross Appearance:

Length 6.2 cm. Colour uniform gray. The hair measures 60 μ in diameter in the proximal region.

Microscopic Appearance:

In the proximal and medial regions, the border of the hair shows scales which are imbricate and at the distal region the borders appear plain. The hair pigment which is punctated and threadlike is seen uniformly in all regions of the hair. Medulla is not visible in any region.

Blacknaped Hare *Lepus ruficaudatus*
Fig. 4

Gross Appearance:

Length 3.5 to 4.8 cm. The hairs are slender and soft, with diameter of 12 μ throughout except for the slight tapering apex. They are light brown in colour with black tips.

Microscopic Appearance:

In the proximal region the medulla appears beaded, in the medial discoidal and in the distal region fragmented. Scales are not visible.

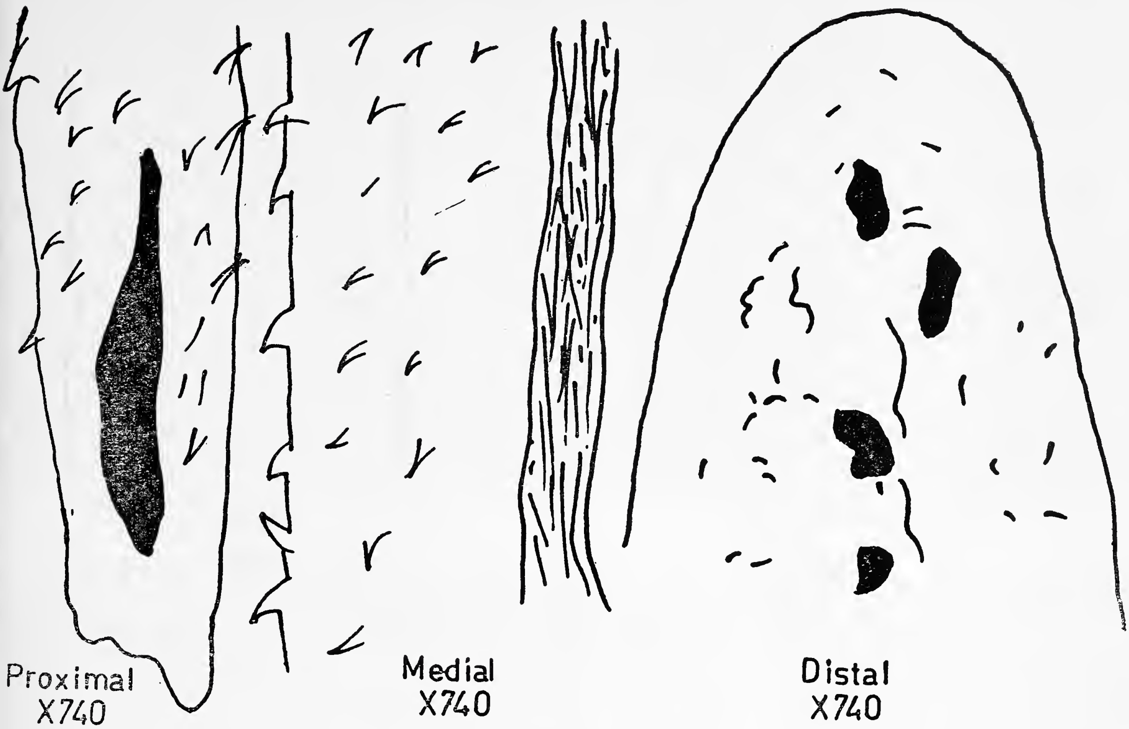

Fig. 1. Pangolin (*Manis pentadactyla*)

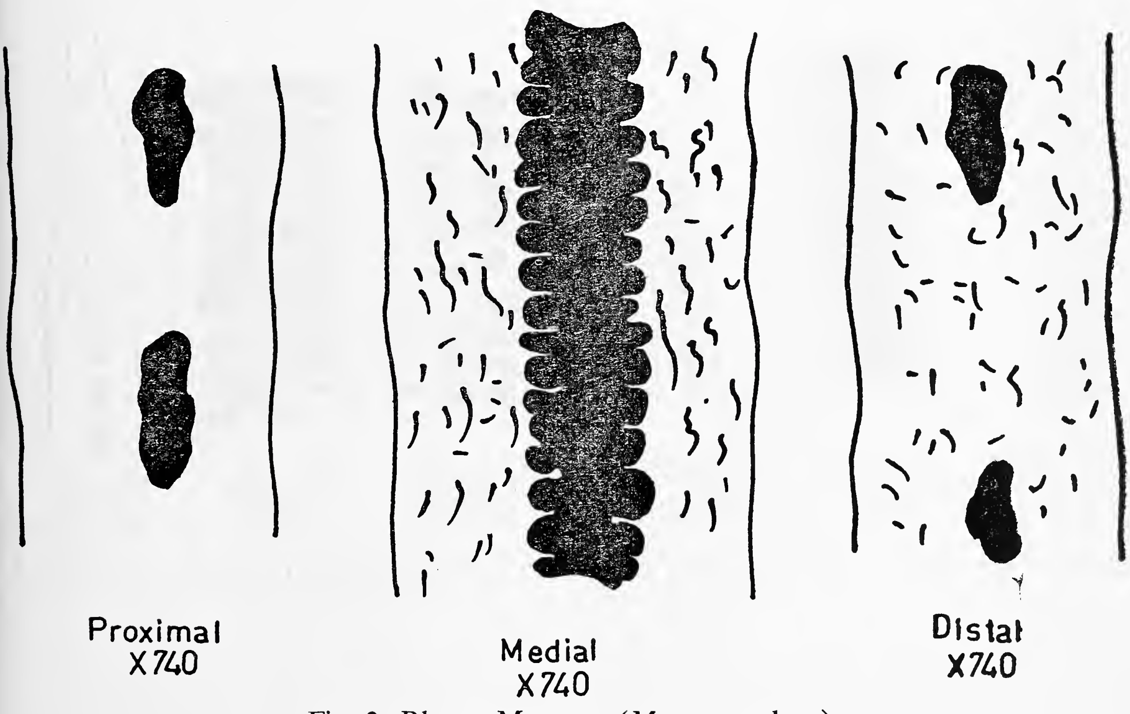

Fig. 2. Rhesus Macaque (*Macaca mulatta*)

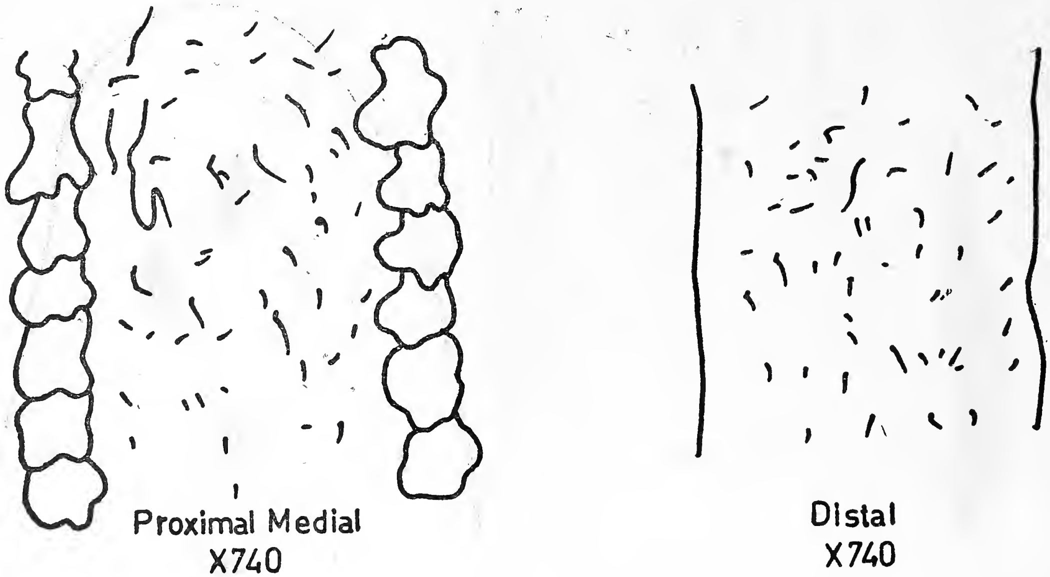

Fig. 3. Langur (*Presbytis entellus*)

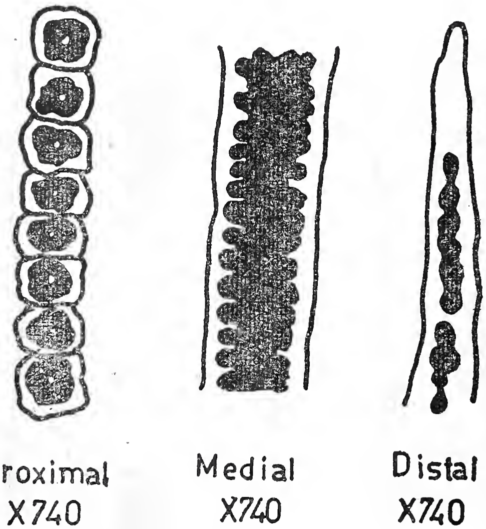

Fig. 4. Blacknaped Hare (*Lepus ruficaudatus*)

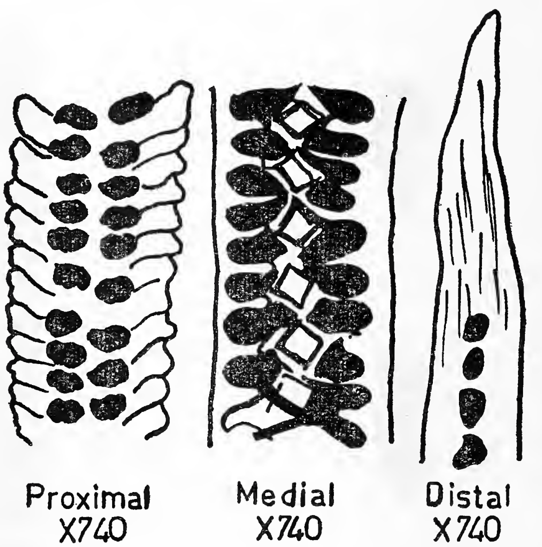

Fig. 5. Palm Squirrel (*Funambulus palmarum*)

PALM SQUIRREL *Funambulus palmarum*
Fig. 5

Gross Appearance:

Length 1.4 to 2 cm. The hairs differ in colour. Some are black and some are banded in appearance with white and brown bands arranged alternatively. They measure 27 μ in diameter in the proximal region.

Microscopic Appearance:

Scales are imbricate with plain edges in the proximal region. In the medial and distal regions the borders appear plain. In the proximal region medulla is of fragmented type arranged in double rows. In the medial region it appears discoidal, which however in the core portion shows a chiasmatic appearance. In the distal region the medulla is of fragmented type.

LESSER BANDICOOT RAT *Bandicota bengalensis*
Fig. 6

Gross Appearance:

Length 2 to 3 cm. The colour of the hair is generally gray except in the distal region which is black. The hair measures 45 μ in diameter in the proximal region.

Microscopic Appearance:

Scales are dentate in the proximal region. In the medial region the borders appear plain while in the distal region the scales are imbricate acuminate.

Medulla in the proximal region appears discoidal while it is continuous in the medial and distal regions.

STRIPED HYENA *Hyaena hyaena*
Fig. 7

Gross Appearance:

The proximal region is white, medial gray and distal black.

Length 16.8 cm. The hairs are straight wire-like with a gradual taper. The diameter of the hair at the proximal region measures 60 μ.

Microscopic Appearance:

No scales are visible and the borders are plain. Medulla in the proximal and medial regions is continuous while in the distal region it is fragmented.

JACKAL *Canis aureus*
Fig. 8

Gross Appearance:

Length 4 to 6 cm. Hair stems are narrow at the proximal region becoming a little broader in the medial and tapering in the distal region. At the broadest portion the hair diameter measures 90 μ. The hairs show a banded coloration due to the presence of brown or black bands which are separated from each other by yellow bands.

Microscopic Appearance:

Scales imbricate acuminate in proximal region, changing to crenate in the medial, and flattened in the distal region giving a smooth appearance to the borders. Medulla is continuous in the proximal region, discoidal giving a horizontal triangular appearance in the medial region and fragmented in the distal region.

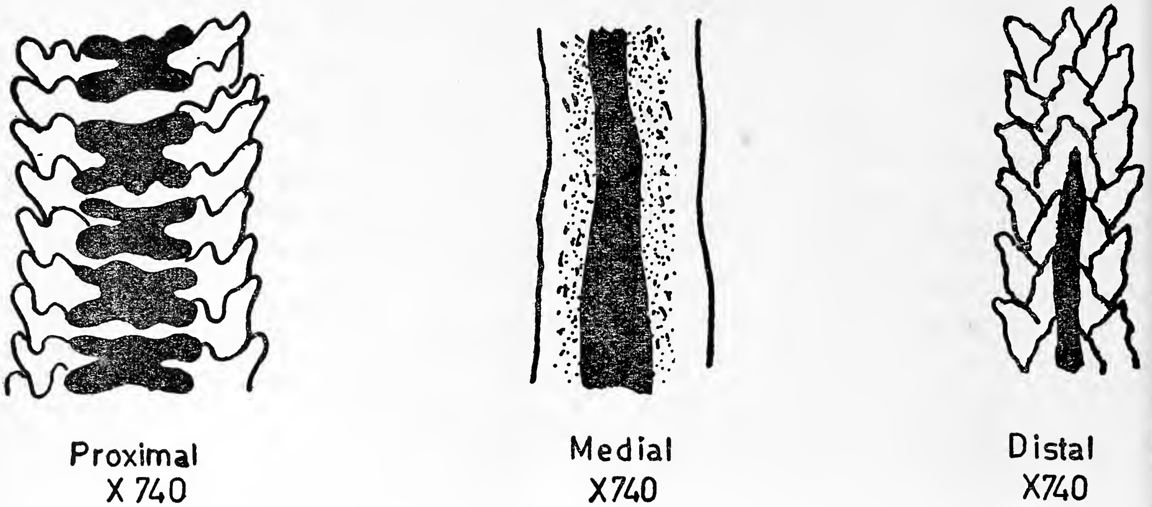

Fig. 6. Lesser Bandicoot Rat (*Bandicota bengalensis*)

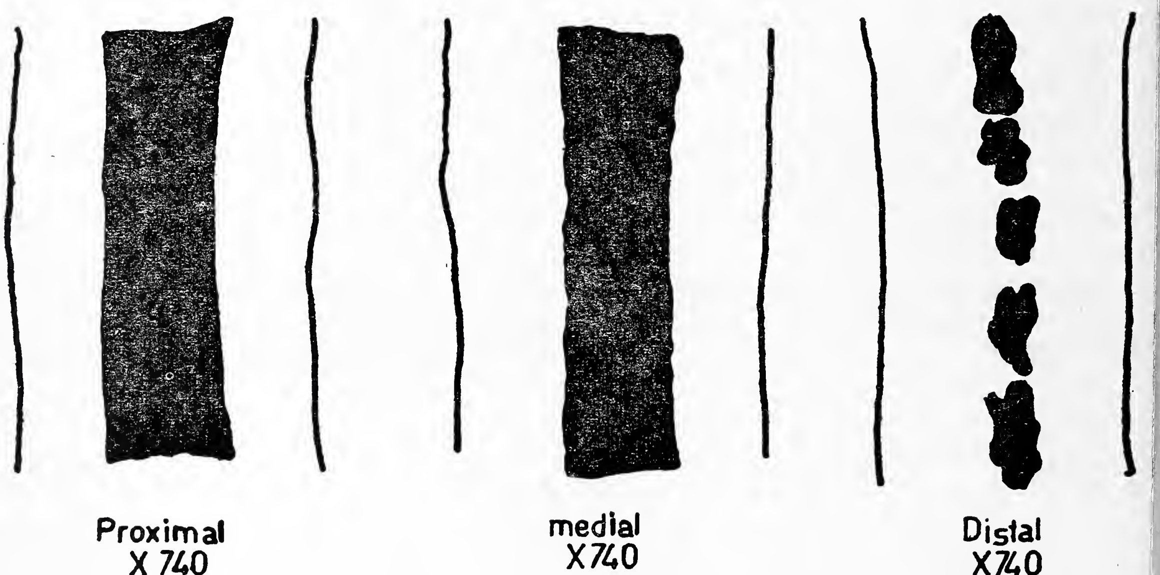

Fig. 7. Striped Hyena (*Hyaena hyaena*)

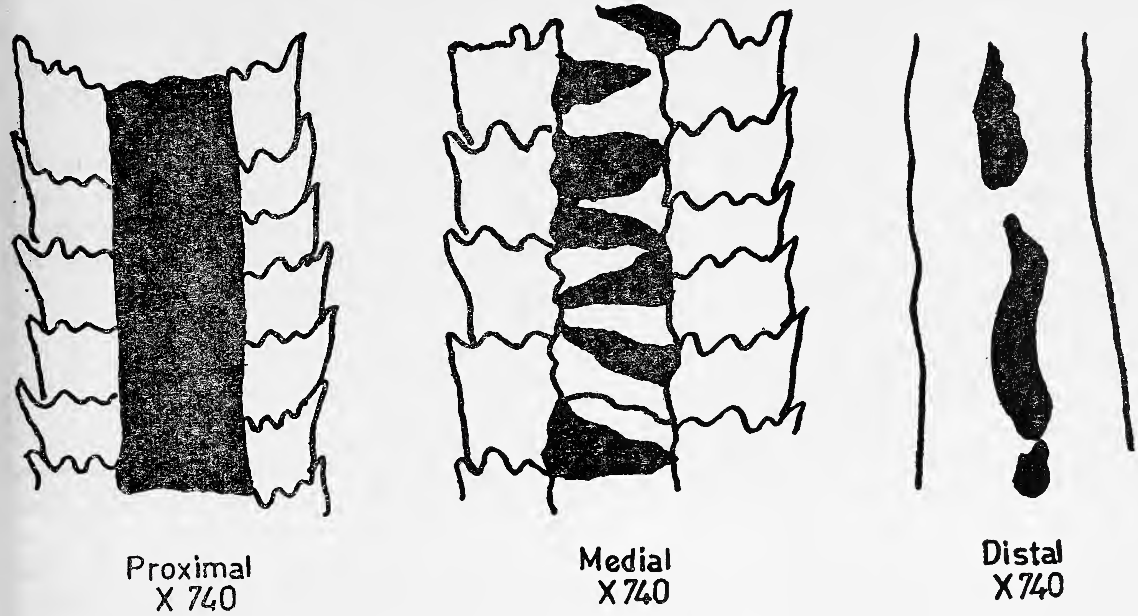

Fig. 8. Jackal (*Canis aureus*)

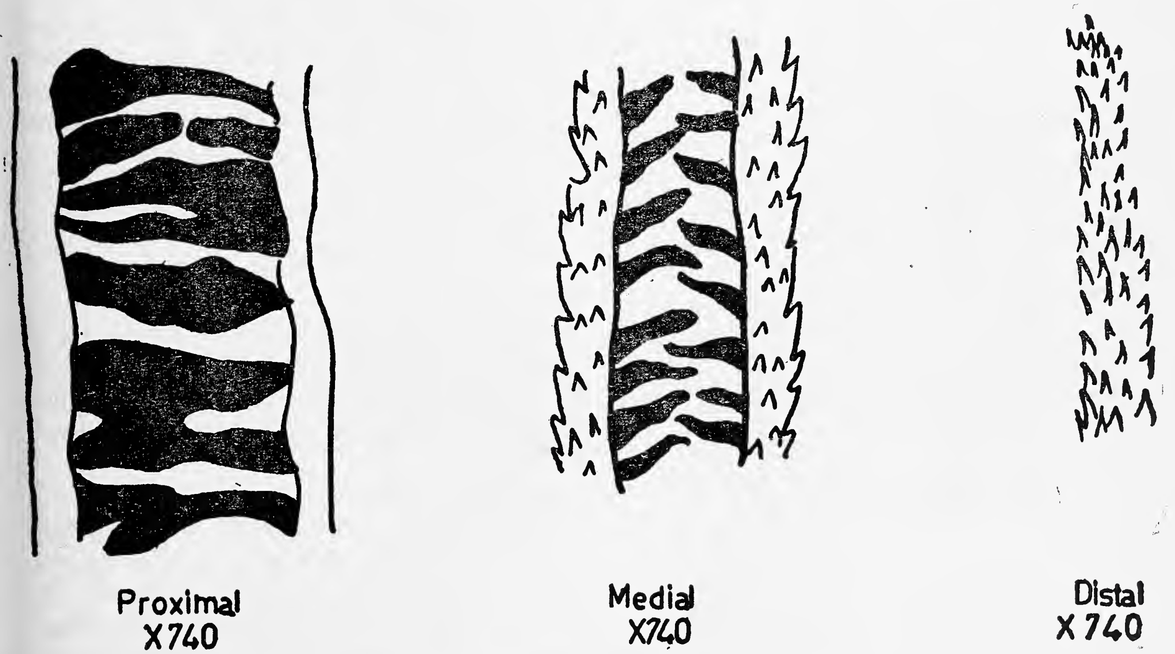

Fig. 9. Indian Fox (*Vulpes bengalensis*)

INDIAN FOX *Vulpes bengalensis*
Fig. 9

Gross Appearance:

Length 4 to 5 cm. They measure 60 μ in the proximal region. Colour black in the distal region and yellow in the proximal region. Some hairs are black except for lighter coloured bands, several centimetres wide in the upper portion of the medial region.

Microscopic Appearance:

Proximal region appears smooth, medial spiny dentate while in the distal region minute spines are seen. Medulla in the proximal region appears discoidal, in the medial intervening fragmented type and in the distal region no medulla is visible.

TIGER *Panthera tigris*
Fig. 10

Gross Appearance:

Length 4 to 8 cm. Hair stems thick, slightly curved at the tip. Diameter at the proximal region 84 μ. Colour of the hair is white in the proximal region, and dark gray in the distal. In the medial region yellow bands are separated from each other by brown bands. Some hairs are pure white and black in colour.

Microscopic Appearance:

In the proximal region the scales appear as spines on the borders, while in the medial and distal regions the borders appear plain. Medulla is continuous throughout except in the distal region where it is not visible.

PANTHER *Panthera pardus*
Fig. 11

Gross Appearance:

Length 3 to 4 cm. Hair stems are soft and slender. Colour light yellow in the proximal region, followed by two bands approximately 5 mm. wide, the first being black and the second brown. The distal portion is yellow. The diameter at the proximal region, 45 μ.

Microscopic Appearance:

Scales imbricate with crenate edges in the proximal and medial regions. In the distal region the borders appear plain. Medulla is continuous throughout except in the distal region where it is fragmented.

JUNGLE CAT *Felis chaus*
Fig. 12

Gross Appearance:

Length 2 to 4 cm. Coloration of hair stems is highly specific. They are light gray from proximal to medial region which is followed by two bands black and brown in the distal region. The tip is black. The diameter at proximal region is 30 μ

Microscopic Appearance:

Scales imbricate with dentate edges in the proximal and medial regions. In the distal region the scales appear to be coronal. Medulla is discoidal in the proximal and medial regions while in the distal region it is continuous.

PALM CIVET *Paradoxurus hermaphroditus*
Fig. 13

Gross Appearance:

Length 2 to 4 cm. Hair stems slightly wavy and soft. The diameter at proximal region is 66 μ. Colour dusty gray in proximal region, gradually becoming darker towards the distal region.

Microscopic Appearance:

Scales imbricate with crenate edges in proximal region, which gradually become coronal in the medial region. In the distal region the borders appear plain. Medulla in the proximal region appears discoidal, in the medial continuous and in the distal fragmented.

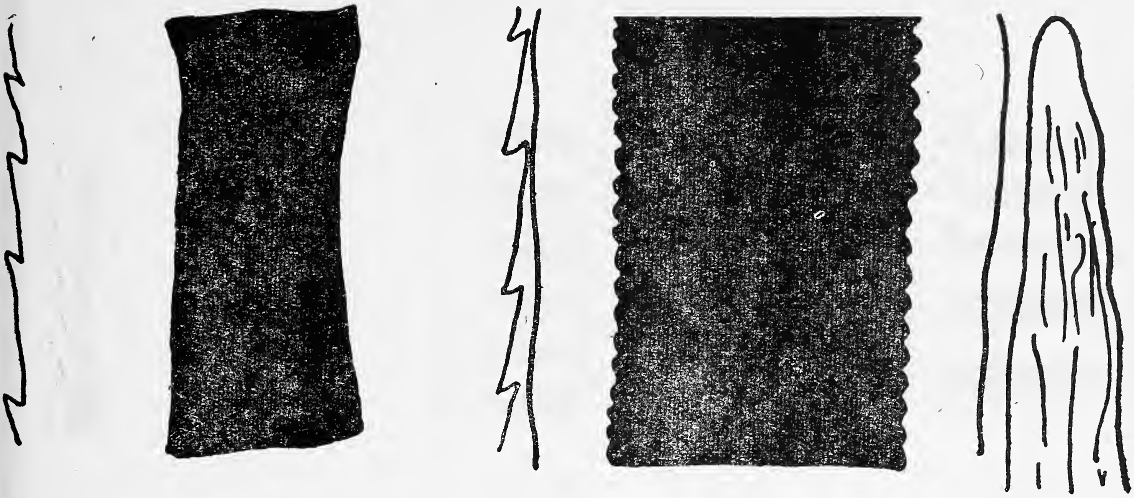

Fig. 10. Tiger (*Panthera tigris*)

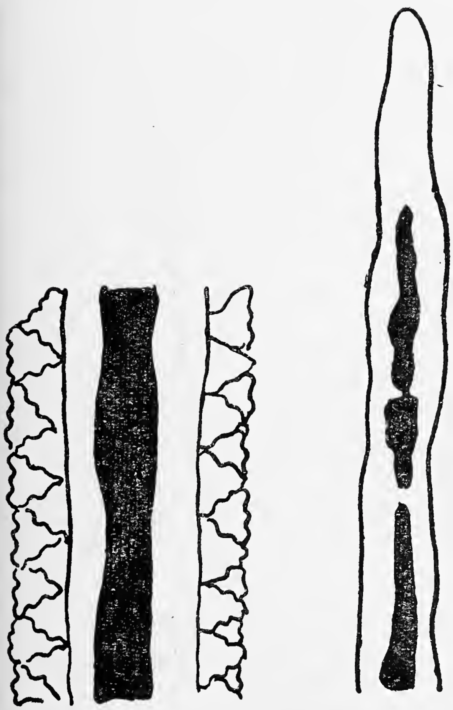

Fig. 11. Panther (*Panthera pardus*)

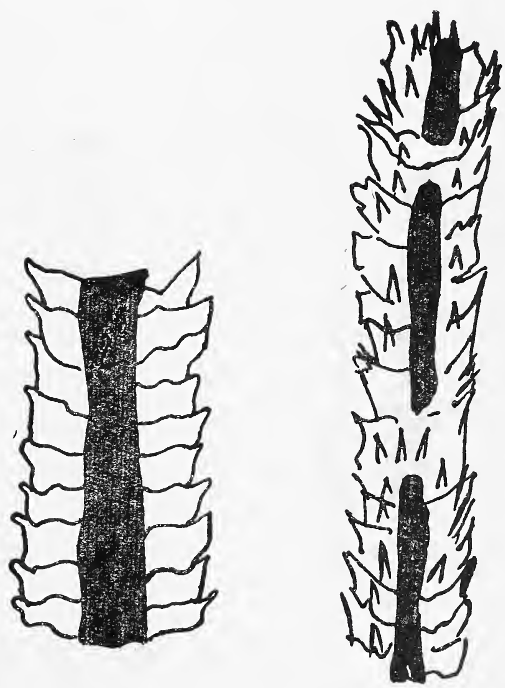

Fig. 16. Cattle (*Bos* sp.)

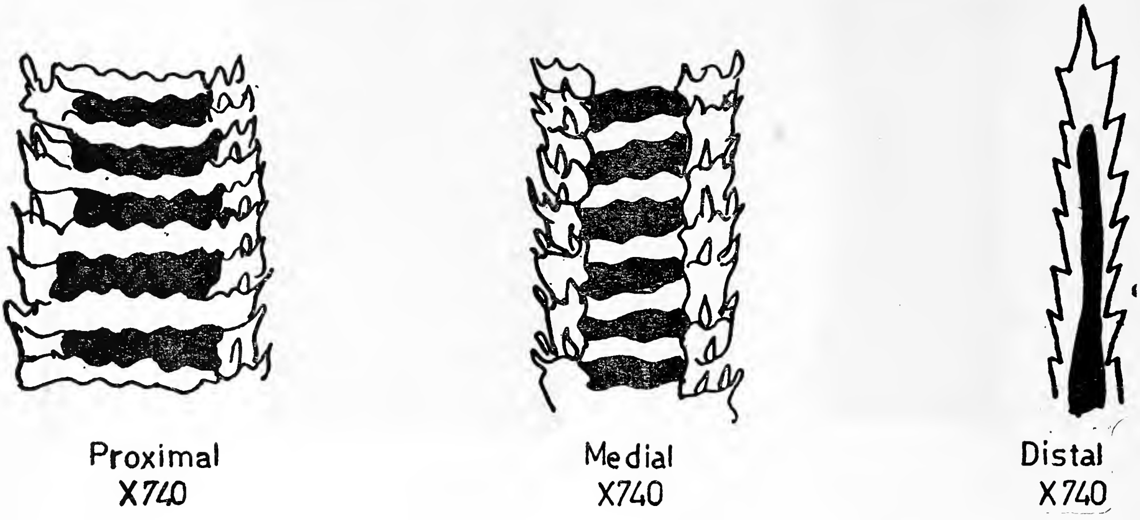

Fig. 12. Jungle Cat (*Felis chaus*)

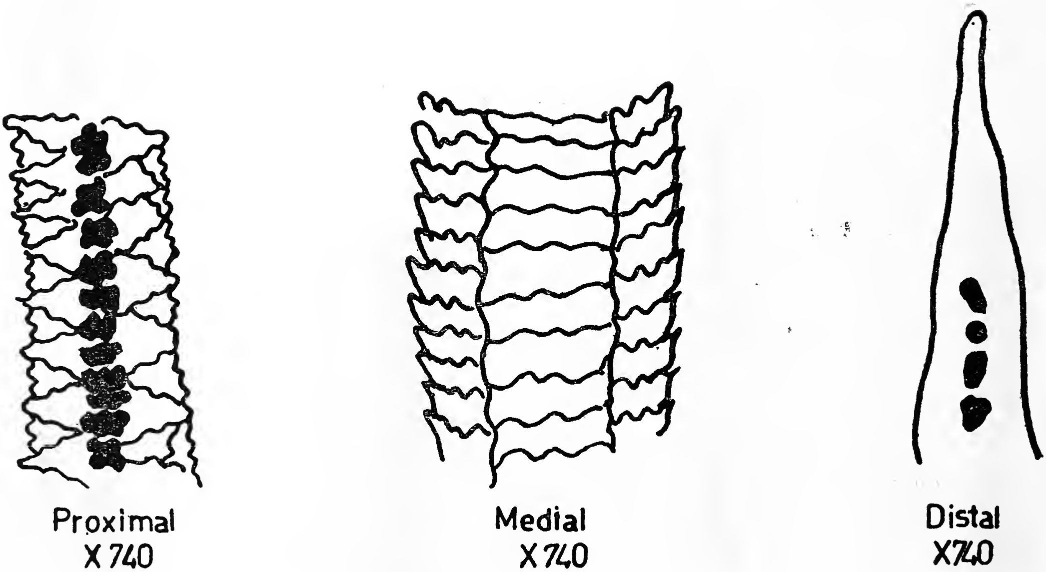

Fig. 13. Palm Civet (*Paradoxurus hermaphroditus*)

RATEL *Mellivora capensis*
Fig. 14

Gross Appearance:

Length 3 to 4 cm. There are two types of hair one pure brown and the other pure white in colour. Both are slightly curved. In the proximal region hair stems are wide but gradually taper towards the distal region. The diameter at the proximal end is 51 μ.

Microscopic Appearance:

Scales coronal with dentate edges in the proximal and the medial regions of the hair. In the distal region scales appear as minute spines. Medulla is continuous in the proximal and medial regions and is not visible in the distal region.

DOMESTIC GOAT *Capra* sp.
Fig. 15

Gross Appearance:

Length 4 to 6 cm. Hair stems are curved and slightly wavy. 42 μ in diameter in the proximal region. The colour of the hair is variable.

Microscopic Appearance:

Scales are imbricate with crenate edges in the proximal region. In the medial and distal regions the borders appear plain. The medulla appears fragmented in the proximal and distal regions while it is discoidal in the medial region.

CATTLE *Bos* sp.
Fig. 16

Gross Appearance:

Length 1 to 2 cm. Hair stems are slightly curved measuring 30 μ in diameter in the proximal region. The colour of the hair is highly variable.

Microscopic Appearance:

Scales are imbricate with crenate edges in the proximal and medial regions. In the distal region they appear flattened with minute spines. The medulla is continuous in the proximal and medial regions and fragmented in the distal region.

SAMBAR *Cervus unicolor*
Fig. 17

Gross Appearance:

Length 3 to 5 cm. Narrow in the proximal region, becoming broader in the medial and tapering off in the distal region. 180 μ in diameter in the medial region. The colour of the hair is almost pure white in the proximal region, gradually changing to yellowish gray in the medial region. The distal region is black.

Microscopic Appearance:

In the proximal region the borders appear smooth. In the medial region the scales are imbricate crenate and in the distal spiny. Medulla shows reticular polygonal appearance in the proximal and medial regions. In the distal region medulla it is not visible.

SPOTTED DEER *Axis axis*
Fig. 18

Gross Appearance:

Length 3 to 4 cm. Hair stems slightly wavy. Diameter at the proximal end 84 μ. Colour, white in the proximal region changing to brown in the medial region. The distal region is yellowish brown.

Microscopic Appearance:

Dark medulla prevents cuticular structural view of the proximal region under microscope. In the medial region scales are imbricate compressed ovate type. Tip of the distal region appears spiny. Medulla appears continuous in the proximal and medial regions and is fragmented in the distal region.

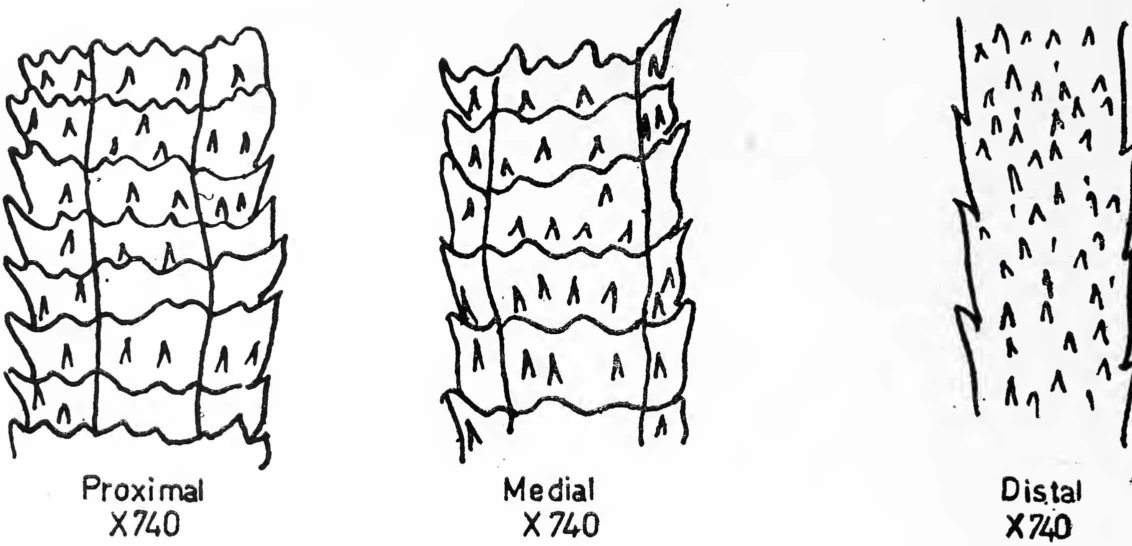

Fig. 14. Ratel (*Mellivora capensis*)

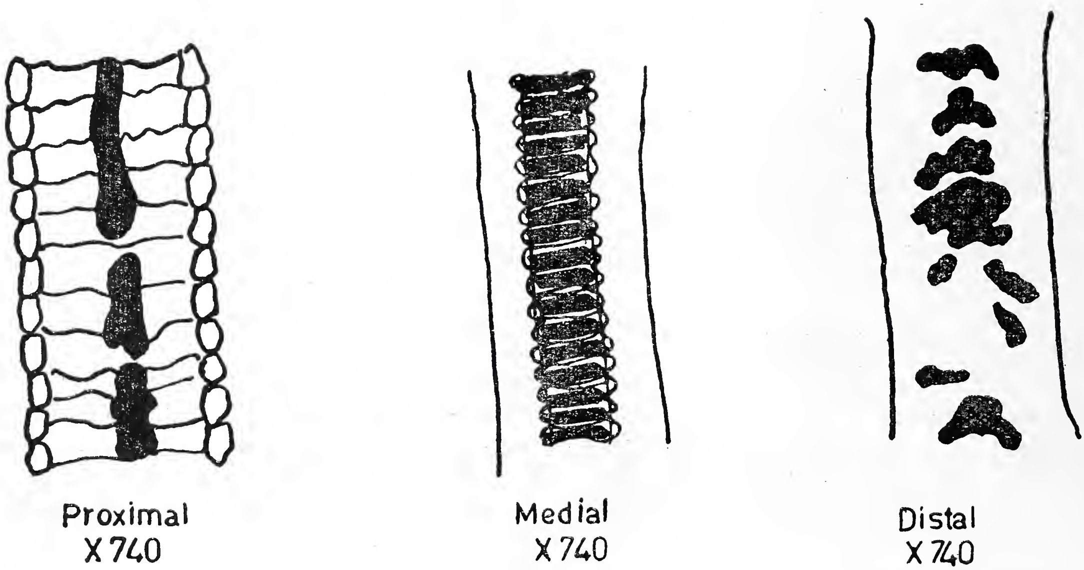

Fig. 15. Domestic Goat (*Capra* sp.)

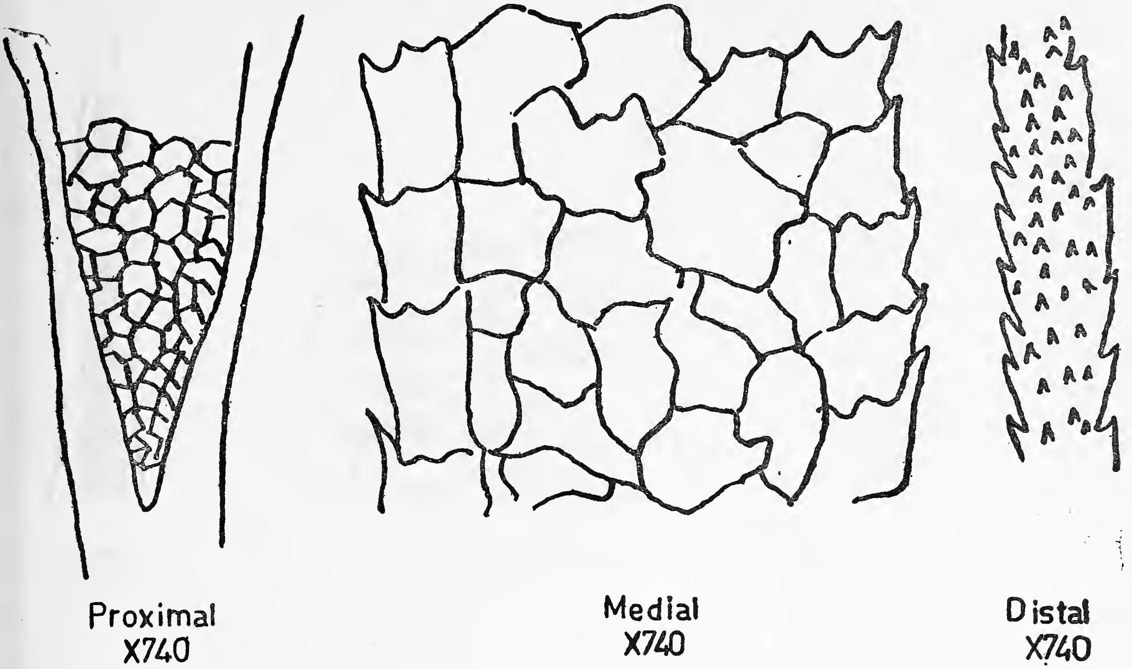

Fig. 17. Sambar (*Cervus unicolor*)

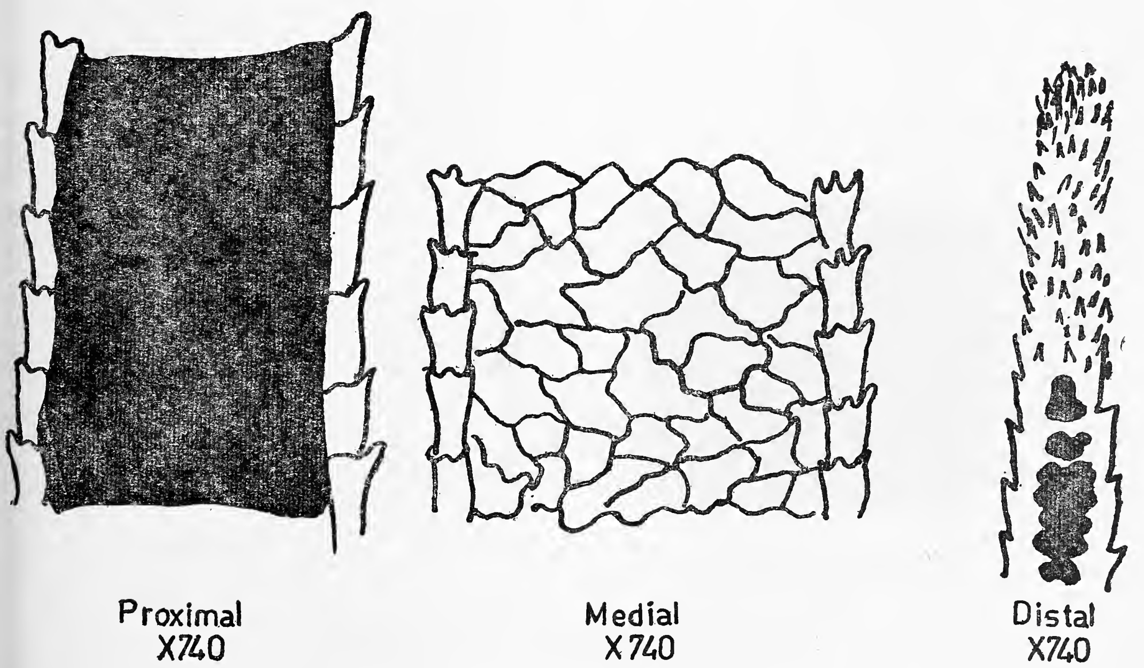

Fig. 18. Spotted Deer (*Axis axis*)

2

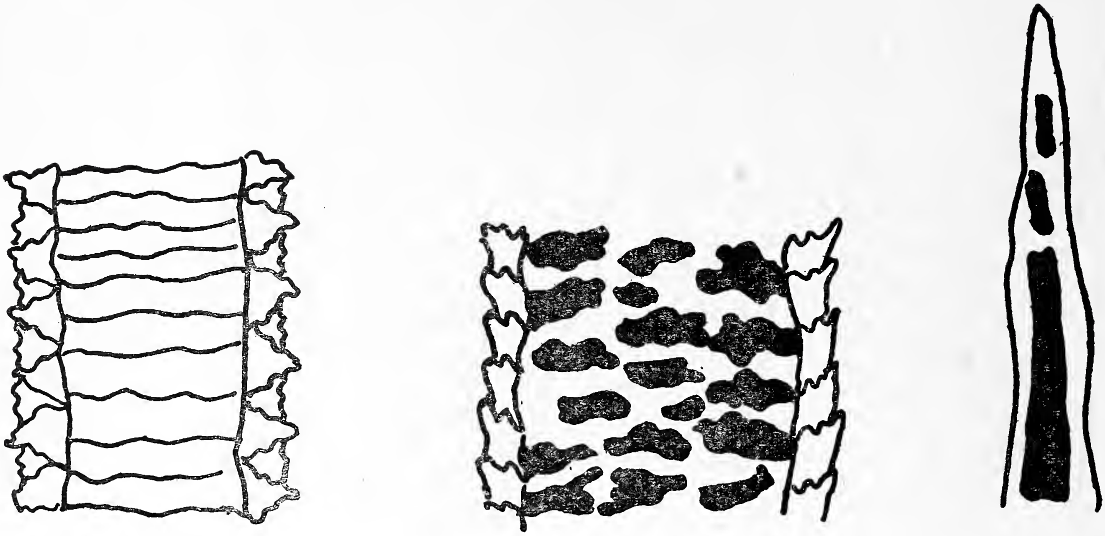

Fig. 19. Blackbuck (*Antilope cervicapra*)

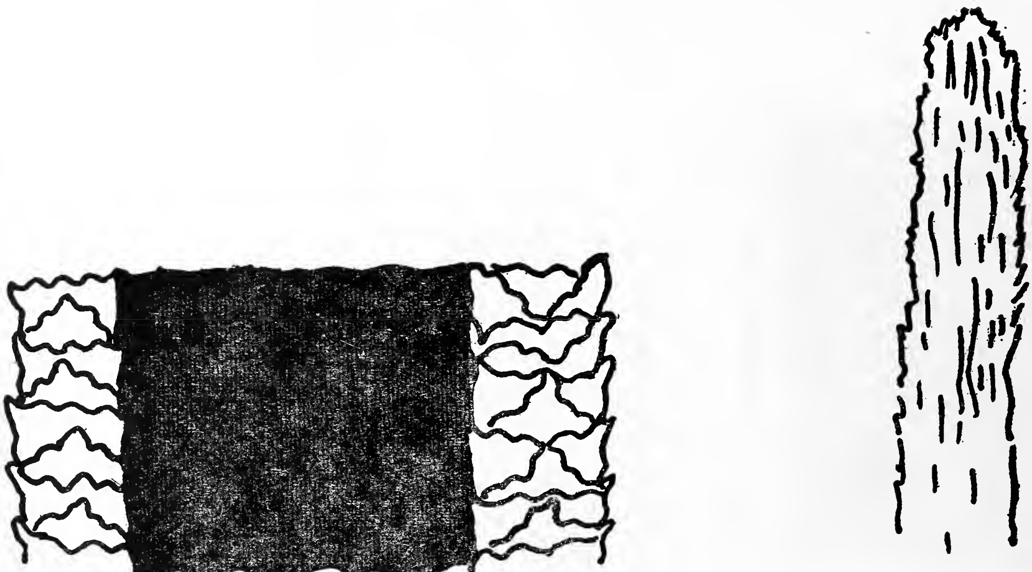

Fig. 20. Nilgai (*Boselaphus tragocamelus*)

BLACKBUCK *Antilope cervicapra*
Fig. 19

Gross Appearance:

Length 1 to 2 cm. The hairs look slightly curved and are more or less equal in diameter throughout except for a gradual taper at the apex. Diameter at the proximal end 48 μ. The colour of the hair is white in the proximal region with grayish coloured band immediately below the distal one third region.

The terminal portion is black. Some hairs are light brown in colour and some white and black.

Microscopic Appearance:

Scales imbricate crenate in the proximal and medial regions. In the distal region the borders appear plain. Medulla is fragmented throughout.

NILGAI *Boselaphus tragocamelus*
Fig. 20

Gross Appearance:

Length 23 to 27 cm. 140 μ in diameter at the proximal region. Stems quite fragile and easily broken. Colour almost white in the proximal region. In the medial region two third portion is brown gradually changing to black in the distal region.

Microscopic Appearance:

Scales imbricate with crenate edges in the proximal and medial regions. In the distal region fine long bristles are seen. Medulla continuous in the proximal-medial regions and is not visible in the distal region.

CHINKARA *Gazella gazella*
Fig. 21

Gross Appearance:

Length 18 to 22 cm. 54 μ in diameter in the proximal region increasing perceptibly in size in the medial region and then gradually tapering in the distal region. At the proximal region colour is generally black, medial region being grayish and the distal region white. Some hairs are pure white.

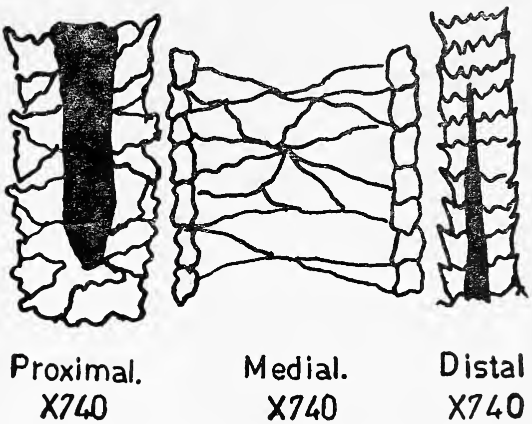

Fig. 21. Chinkara (*Gazella gazella*)

Microscopic Appearance:

Scales are imbricate crenate in the proximal region, gradually becoming flattened compressed ovate type in the medial region. In the distal region the scales are coronal serrate type. Medulla is continuous all throughout.

ACKNOWLEDGEMENTS

We express our thanks to Shri S. S. Buit, Chief Conservator of Forests, Maharashtra State, for his keen interest shown during the progress of this investigation and for giving encouragement from time to time. We also express our thanks to Prof. S. A. R. Quadri, Head of the Zoology Department, Vidarbha Mahavidyalaya, Amravati for providing necessary facilities to undertake the investigation.

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A contribution to the flora of Bastar (Madhya Pradesh)[1]

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The present paper records 319 species of vascular plants which are reported for the first time from Bastar. Fourteen species (marked by double asterisk) are new records for Central India and eighteen (marked by single asterisk) for Madhya Pradesh.

Introduction

Bastar, the largest district of Madhya Pradesh and third largest district of India with an area of 39171 square kilometres lies between 17° 45′-20°23′ north and 80°15′-82°15′ east. It is situated on extreme south of the State, bordered on the three sides by Orissa. Andhra Pradesh and Maharashtra.

The botany of Bastar presents an interesting study since the southern limit of sal is reached about 18°30′ north. A number of species of the south and coastal regions make their appearance here. The hill range Bailadilla presents an interesting flora.

After Mooney's (1942) account of the flora of Bailadilla hill, no contribution to the flora of Bastar was made till recently when Subramanyam & Henry (1966) published a list of 481 species of vascular plants, which was the outcome of their three collection tours. Jain (1963, 1964, 1965) has made contributions towards the ethnobotany of the region. Arora (1968) made further contribution to the botany of Bailadilla. Casual reference of the area has also been made by Tiwari (1954, 1955, 1963, 1964), Tiwari & Maheshwari (1963, 1964, 1965), Panigrahi *et al.* (1965, 1966, 1967), Ramlal & Panigrahi (1967), and Shukla & Panigrahi (1967).

The list that follows enumerates 319 species of vascular plants which are reported for the first time from Bastar; of this eighteen species are new records for Madhya Pradesh (marked by single asterisk) and fourteen for central India (marked by double asterisk). This report is based on five years intensive touring in the area in different seasons of the year. The herbarium specimens cited, are preserved in the Herbarium, State Forest Research Institute, Jabalpur.

Dilleniaceae

Dillenia aurea Sm.
Tirathgarh, Dantewada. *Saxena* 5492; *Khotele* 6085, 9347. Local name: *Mechi.*

Papaveraceae

Argemone mexicana Linn.
Chotedongar. *Khotele* 3076, 5237; *Khotele* & *Shukla* 7249. Local name: *Piladhatura, Katai.*

Violaceae

Hybanthus enneaspermus (Linn.) F. v. Muell.
Awapalli, Bhairamgarh, Kanker, Geedam. *Khotele* 9385, 3309, 11504.

[1] Accepted March 1972.
[2] *Present address*: Regional Research Laboratory, Bhubaneswar.

Capparaceae

Capparis zeylanica Linn. (non Fl. Brit. Ind.)
Bastar. *Khotele* 5270.

Cleome viscosa Linn.
Bhopalpatnam. *Khotele* 4407, 8776.

Bixaceae

Bixa orallana Linn.
Bastar. *Singh* 4397.

Pittosporaceae

** *Pittosporum nepaulense* (DC.) Rehder ex Wilson. var. *rawalpindiense* Gowda
Bailadilla, Dantewada. *Khotele* 8050.

Polygalaceae

Polygala chinensis Linn.
Keshkal, Bhopalpatnam, Marta, *Saxena* 1785; *Khotele* 3038; *Singh* 7164.

P. elongata Klein ex Willd.
Tirathgarh, Kutumsar, Marta. *Saxena* & *Khotele* 6526; *Khotele* & *Shukla* 7398; *Singh* 7166.

P. longifolia Poir.
Badedongar. *Khotele* 8521.

P. persicariaefolia DC.
Manikpur. *Saxena* 1443.

Caryophyllaceae

Polycarpon indicum (Retz.) Merr.
syn. *Polycarpon loeflingii* (Wall.) Benth. & Hk. f.
Tirathgarh. *Khotele* 6523.

Portulacaceae

Portulaca oleracea Linn.
Bhopalpatnam. *Khotele* 8769.

Tamariscineae

Tamarix eriocoides Rottl.
Bhopalpatnam. *Khotele* 8779.

Elatinaceae

Bergia ammanioides Roxb.
Budra, Bhopalpatnam. *Khotele* 3418, 8768.

Hypericaceae

Hypericum javanicum Thunb.
Gadantari. *Khotele* 5297. Local name: *Kurandi.*

Malvaceae

Abutilon hirtum G. Don
syn. *A. graveolens* W. & A.
Bhairamgarh. *Khotele* 9354.

Hibiscus micranthus Linn. f.
Kanker. *Khotele* 2013.

H. sabdariffa Linn.
Dhondai, Narainpur. *Khotele* 4028, 4072, 8325.

H. tetraphyllus Roxb.
Kirandul. *Saxena* 1365.

Tiliaceae

Corchorus olitorius Linn.
Kirandul. *Saxena* 1358.

Grewia subinaequalis DC.
Awapalli. *Khotele* 9357.

Oxalidaceae

Biophytum reinwardtii (Zucc.) Klotz.
Amabeda-Antagarh, Kanker, Bhanupratappur, Keshkal. *Khotele* 2049, 2593; *Shukla* 5314. Local name: *Jukku.*

Oxalis corniculata Linn.
Common weed. *Singh* 4301, 6766; *Khotele* 3084, 5271. Local name: *Kodey.*

Rutaceae

Citrus medica Linn.
Bhansi. *Saxena* 1412.

Hesperethusa crenulata (Roxb.) Roem
Dantewada. *Saxena* 1213.

Ochnaceae

**Ochna gamblei* King
Darbha. *Saxena* 5436; *Khotele* 9003, 9340.

Olacaceae

Olax nana Wall.
Purva Kameli. *Khotele* 9074.

Vitaceae

Cayratia carnosa Gagnep.
Keshkal. *Saxena* & *Khotele* 1807.

Cissus vitiginea Linn.
syn. *Vitis linnei* Wall. ex W. & A.
Nunalguda. *Singh* 27131.

Sapindaceae

Cardiospermum helicacabum Linn.
Sukma. *Saxena* 5675.

Erioglossum rubiginosum Bl.
syn. *E. edule* Bl.
Bhainsgaon, Narainpur. *Khotele* 5038.

Moringaceae

Moringa oleifera Lamk.
Kosalnar-Kondagaon. *Khotele* 3427, 5278. Local name: *Munga.*

Papilionaceae

Aeschynomene aspera Linn.
Bhairamgarh. *Khotele* 9333.

Alysicarpus glumaceous (Vahl) DC.
syn. *A. rugosus* DC.
Bastar. *Khotele* 11528.

Alysicarpus procumbens (Roxb.) Schindl.
syn. *A. hamosus* Edgew.
Kanker. *Khotele* 10196.

Alysicarpus vaginalis (Linn.) DC.
Common. *Saxena* 1549, 1827; *Khotele* 3040, 3882, 3110, 5295; *Singh* 4366. Local name: *Bhuikumra, Phadkuli.*

Clitoria ternatea Linn.
Jagdalpur. *Khotele* & *Shukla* 6466.

Crotalaria alata Buch.-Ham.
Kondagaon. *Saxena* & *Khotele* 1956; *Khotele* 10378.

C. calycina Schrank
Beejapur, Kutumsar, Korar, Geedam. *Singh* 2361; *Khotele* & *Shukla* 6426, 6457; *Khotele* 8417, 10398.

* *C. humifusa* Grah.
Godantari-Kondagaon. *Khotele* 5291.

C. laburnifolia Linn.
Jagdalpur, Darbha. *Khotele* 3491, 10213.

C. prostrata Rottl. ex Willd.
Bodegaon-Antagarh, Narainpur, Darbha, Kirandul, Bhansi. *Khotele* 2076, 4020, 10216; *Saxena* 1410; *Singh* 2581.

Dalbergia sissoo Roxb. ex DC.
Pharasgaon. *Khotele* 8541.

Desmodium dichotomum (Wild.) DC.
syn. *Desmodium diffusum* Willd.
Keshkal. *Saxena* 1583.

Desmodium triflorum (Linn.) DC.
Narainpur, Beejapur, Antagarh. *Khotele* 4013; *Singh* 2202, 2234.

Desmodium velutinum (Willd.) DC. var. *velutinum*
Kanker, Kirandul, Pharasgaon, Sambalpur, Bhanupratappur, Bhansi, Jagdalpur. *Saxena* 1308; *Singh* 2424, 2568; *Khotele* 2061, 3028, 7220, 8514. Local name: *Badi Chatkani.*

Dolichos biflorus Linn.
Dhondai, Narainpur. *Khotele* 4061, 8326.

Eleiotis monophylla (Burm. f.) DC.
Sukma. *Khotele* 10359, 10397.

Indigofera glandulosa Roxb. ex Willd.
Maita. *Singh* 7156.

I. linifolia (Linn. f.) Retz.
Dantewada, Duhdawa, Antagarh, Jharandalli-Bhanupratappur. *Saxena* 1237, 1523; *Khotele* 3054, 4012, 8749.

I. trifoliata Linn.
Dantewada, Bodegaon, Amraoti. *Khotele* 2095, 2866, 6250.

Phaseolus mungo Linn.
Narainpur: escape in forest. *Khotele* 4044.

P. aureus Roxb.
(*Phaseolus radiatus* auct. non Linn.)
Narainpur, Keshkal. *Khotele* 4045; *Khotele* & *Shukla* 5353. Local name: *Paail.*

** *Pseudarthria viscida* (Linn.) W. & A.
Bhairamgarh, Kondagaon. *Khotele* 3114.

Rhynchosia minima DC.
Jagdalpur. *Khotele* 11530.

Sesbania aegyptiaca Pers.
Keshkal. *Khotele* 5383.

Tephrosia hamiltonii Drum.
(*Tephrosia purpurea* sensu Baker in Fl. Brit. Ind.)

Keshkal, Dantewada, Dudhawa, Sukma. *Saxena* 1521; *Saxena* & *Khotele* 1776; *Khotele* & *Shukla* 7224; *Khotele* 10361; *Singh* 2486. Local name: *Dumar, Bajradanti.*

** *T. lanceolata* Grah. ex W. & A.

Bispur. *Khotele* & *Shukla* 7323.

Teramnus labialis (Linn. f.) Spreng.
Bailadilla. *Singh* 2567; *Saxena* 1310.

Trigonella foenum-graecum Linn.
Bhanupratappur. *Khotele* 8834.

Vigna vexillata (Linn.) A. Rich.
Antagarh, Narainpur. *Khotele* 2070, 4046, 10399. Local name: *Barbela.*

Zornia gibbosa Spanoghe
Bailadilla, Darbha, Dudhawa, Dodegaon, Bhainsgaon, Narainpur. *Saxena* 1555; *Khotele* & *Shukla* 7281; *Khotele* 2094, 3170, 10295.

CAESALPINIACEAE

Caesalpinia bonduc (Linn.) Roxb.
Narainpur, Bhopalpatnam. *Khotele* 4038, 8829. Local name: *Ghataran.*

Cassia absus Linn.
Bhiragaon-Narainpur, Konta. *Khotele* 3166; *Singh* 7181.

C. auriculata Linn.
Bastar, Narainpur. *Srivastava* & *Party* 99113 (LWG).

C. mimosoides Linn.
Kanker, Antagarh, Bodegaon, Bhiragaon, Kondagaon, Kutumsar. *Khotele* 2028, 3008, 3091, 3377; *Khotele* & *Singh* 6419.

C. pumila Linn.
Beejapur, Keshkal. *Singh* 2378; *Khotele* & *Shukla* 5372.

MIMOSACEAE

Acacia nilotica (Linn.) Del. subsp. *indica* (Benth.) Brenan (*Acacia arabica*)
Jagdalpur. *Khotele* 6286.

A. auriculiformis A. Cunn.
Jagdalpur—Cultivated. *Khotele* 2815.

Albizzia amara Boiv.
Dantewada. *Saxena* 1230.

* *Albizzia thomsonii* Brand.

Tirathgarh, Sukma. *Saxena* 5495, 5629.

Mimosa rubicaulis Lam.
Bhopalpatnam. *Khotele* 8711.

ROSACEAE

** *Pyrus pashia* Buch.-Ham.

Kunharas Forest. *Fr.* July. *Singh* 6774. Local name: *Banghuiyan.*

COMBRETACEAE

Anogeissus pendula Edgew.
Sukma, Pangam, Bhopalpatnam. *Saxena* 5647; *Khotele* 8732, 8733.

LYTHRACEAE

Ammannia baccifera Linn.
Bhopalpatnam, Bhanubeda, Bhiragaon, Kesalnar-Kondagaon, Dantewada, Keshkal, Dudhawa, Bhansi. *Saxena* 1183, 1290, 1526, 3467; *Khotele* 3113, 3321, 5274.

A. baccifera Linn. var. *aegyptiaca* Koehne
Syn. *A. salicifolia* Hiern. non Monti.

Kondagaon. *Khotele* 5287.

Rotala mexicana Cham. & Schecht
Syn. *Ammannia pygamaea* S. Kurz.

Darbha. *Khotele* 9566.

ONAGRACEAE

Ludwigia adscendens (Linn.) Hara
Syn. *Jussiaea repens* Linn.
Darbha. *Saxena* & *Khotele* 1679. Local name: *Jagni.*

SAMYDACEAE

Casearia elliptica Willd.
Syn. *C. tomentosa* Roxb.

Bhansi. *Saxena* 1335.

CUCURBITACEAE

Coccinia cordifolia (Linn.) Cogn.
Dantewada, Dhodai. *Khotele* 2873, 4076.

Corallocarpus epigaeus (Rottl. & Willd.) C.B. Cl.
Antagarh. *Khotele* 2079; *Singh* 6609.

Cucumis sativus Linn.

Kirandul, Keshkal. *Singh* 2590; *Khotele & Singh* 5362. Local name: *Bodella.*

Diplocyclos palmatus (Linn.) Jaffrey
Darbha, Kirandul. *Khotele* 3375, 10209; *Singh* 2593. Local name: *Beliabuti, Kochri, Chrabuti.*

Melothria maderaspatana (Linn.) Cogn.
Kirandul, Bhansi, Kanker. *Singh* 2540; *Saxena* 1320; *Khotele* 2016.

Momordica charantia Linn.
Sukma, Tirathgarh. *Saxena* 1632, 5662.

M. dioica Roxb. ex Willd.
Dornapal, Tongpal. *Singh* 7002, 7095. Local name: *Khaksi, Van Karela.*

Trichosanthes bracteata (Lam.) Voigt
Dondai, Sukma, Geedam, Kanker. *Khotele* 4075, 2046, 10256, 10376.

T. cucumeriana Linn.
Kanker, Jagdalpur. *Khotele* 2015; *Khotele & Shukla* 6468.

CACTACEAE

Opuntia monacantha Haw.
Kanker. *Saxena* s.n.

FICOIDEAE

Glinus oppositifolia (Linn.) A. DC.
Dudhawa, Sukma. *Saxena* 7535, 5651.

UMBELLIFERAE

Centella asiatica (Linn.) Urban
Bhansi, Sonpur, Darbha. *Khotele* 5078, 9582; *Saxena* 1408.

* *Eryngium foetidum* Linn.
Darbha. *Saxena* 5416. Local name: *Dhaniya.*

Hydrocotyle sibthorpioides Lam.
Darbha. *Khotele* 9581. Local name: *Choti Brahmi.*

Peucedanum nagpurense Prain
Keshkal. *Khotele* 5343.

Trachyspermum roxburghianum (DC.) Craib
Korar. *Khotele* 8439.

RUBIACEAE

Dentella repens Forst.
Jagdalpur, Bhopalpatnam, Sukma, Dudhawa. *Saxena* 1536, 3490, 5651, 5655, 5663.

Gonotheca ovatifolia (Cav.) Sant. & Wagh
Syn. *Oldenlandia nudicaulis* Roth
Dantewada, Kirandul, Beejapur, Keshkal. *Saxena* 1366; *Khotele* 8020; *Singh* 2222; *Khotele & Shukla* 5417.

Hedyotis hispida Retz.
Darbha, Kirandul, Bhansi, Bispur. *Saxena* 1406, 5405; *Khotele* 10321; *Singh* 4212. Local name: *Ronder.*

Rubia cordifolia Linn.
Bhansi, Bailadilla. *Saxena* 1294; *Singh* 4273.

* *Tarenna asiatica* (Linn.) Alston
Syn. *Webera corymbosa* Willd.
Bastar, between Narainpur and Dhamtari. *Srivastava* 9915 (LWG).

COMPOSITAE

Amberboa ramosa (Roxb.) Wagenitz.
Syn. *Voluterella divaricata* Benth.
Dudhawa. *Saxena* 1545.

Blainvillea acmella (Linn.) Phillipson
Kanker. *Singh* 2236; *Khotele* 2041.

Bidens pilosa Linn.
Bhansi, Kirandul, Kanker. *Saxena* 1429; *Singh* 4214; *Khotele* 2011.

* *Blumea hieracifolia* DC.
Keshkal. *Saxena* 1570.

B. laciniata (Roxb.) DC.
Bhanupratappur. *Khotele* 8566.

B. oxyodonta DC.
Dudhawa, Amabeda, Dantewada. *Saxena* 1170, 1173, 1525; *Khotele* 8468, 8568.

B. virens DC.
Bailadilla. *Saxena* 1285; *Khotele* 8358.

Centipeda minima (Linn.) A. Br. & Aschers
Jagdalpur, Bhanupratappur. *Khotele* 8547, 11516.

Centratherum anthelminticum (Willd.) D. Ktze.
Kirandul, Antagarh. *Singh* 2530; *Khotele* 3376. Local name: *Kappur.*

Chrysanthellum indicum DC.
Kanker, Tirathgarh. *Khotele* 1986, 6509.

Conyza aegyptiaca Ait.
Keshkal, Amraoti. *Saxena & Khotele* 1695; *Khotele* 6244.

C. canadensis (Linn.) Conquist; Cuatr. in Webbia 24:222, 1969.
Syn. *Erigeron canadensis* Linn.

Kanger Nala, Bailadilla, Geedam. *Saxena* 5553; *Singh* 6796; *Khotele* 6933.

Cosmos sulphureus Cav.
Antagarh, Kirandul, Geedam, Darbha: escape from cultivation; often abundant in patches. *Singh* 2546, 3372, 9586, 10252.

Crassocephalum crepidioides (Benth.) S. Moore
Syn. *Gynura crepidioides* Benth.

Bailadilla, Bhansi, Dantewada, Kutumsar. *Khotele* 8025, 9023; *Khotele & Shukla* 6451; *Saxena* 1444.

Glossogyne bidens (Retz.) Alston
Syn. *G. pinnatifida* DC.
Budra, Tirathgarh, Kosalnar, Kondagaon, Amraoti, Dantewada. *Saxena* 1634, 5464; *Khotele* 2853, 5281, 6201, 6237. Local name: *Tejraj, Dhaniyabuta, Datkuda.*

Sclerocarpus africanus Jacq.
Darbha, Basanpur, Dantewada, Bispur. *Saxena* 5446; *Khotele* 8024; *Khotele & Shukla* 7308.

Siegesbeckia orientalis Linn.
Bailadilla. *Singh* 4318. Local name: *Katkan.*

Sonchus asper Vill.
Bailadilla. *Singh* 2259.

Tridax procumbens Linn.
Common. *Khotele & Shukla* 5398; *Khotele* 4019, 5293.

Xanthium strumarium Linn.
Geedam. *Singh* 4349. Local name: *Kutraiya.*

STYLIDIACEAE

** *Stylidium kunthii* Wall.
Bispur, Darbha. *Khotele* 10330.

CAMPANULACEAE

Wahlenbergia marginata (Thunb.) A. DC.
Dantewada, Chhotedongar, Jagdalpur, *Saxena* 1177; *Khotele* 3492, 5225, 5226.

PRIMULACEAE

Lysimachia obovata Hk. f.
Bailadilla. *Singh* 2274.

MYRSINACEAE

** *Ardisia floribunda* Wall.
Syn. *A. neriifolia* Wall.
Purva Kameli. *Khotele* 9061.

SAPOTACEAE

Madhuca indica Gmel.
Syn. *M. latifolia* (Roxb.) Macbride
Bhairamgarh, Bhansi. *Saxena* 1427; *Khotele* 9381.

EBENACEAE

Diospyrus exsculpta Buch.-Ham.
Syn. *D. tomentosa* Roxb.
Sukma, Bhairamgarh. *Saxena* 3685; *Khotele* 3096. Local name: *Tendu.*

OLEACEAE

Jasminum multiflorum (Burm. f.) Andr.
Jagdalpur. *Khotele* 3487.

J. officinale Linn.
Bailadilla, Amraoti: escape. *Singh* 6638; *Khotele* 6274.

APOCYNACEAE

Alstonia scholaris R. Br.
Bhansi. *Saxena* 1340.

Catharanthus pusillus G. Don
Kanker. *Khotele* 2068.

Tabernaemontana divaricata (Linn.) R. Br.
Jagdalpur—planted. *Khotele* 2816.

Vallaris heynei Spreng.
Jagdalpur. *Khotele & Shukla* 6471.

Wrightia tomentosa (Roxb.) R. & S.
Tongpal. *Singh* 7047. Local name: *Kudegada, Dudhia.*

ASCLEPIADACEAE

Cryptolepis buchananii R. & S.
Badedongar. *Khotele* 1973, 8501.

Pergularia daemia (Forsk.) Chiov.
Bhopalpatnam. *Khotele* 8778.

Holostemma annularis (Roxb.) K. Schum.
Syn. *H. rheedii* (Wall.) Spreng.

Kondagaon. *Saxena* & *Khotele* 1866. Local name: *Dudhi.*

Sarcostemma acidum (Roxb.) Voight
Syn. *S. brevistigma* W. & A.
Korar. *Khotele* 8446.

* *Tylophora fasciculata* Buch.-Ham.
Tongpal. *Singh* 7072. Local name: *Urwa Tonda.*

Loganiaceae

Strychnos nux-vomica Linn.
Tirathgarh. *Saxena* 5509.

Gentianaceae

* *Exacum pumilum* Griseb.
Dodagaon, Antagarh. *Khotele* 2088.

Boraginaceae

Coldenia procumbens Linn.
Dudhawa, Dantewada, Sukma, Tongpal. *Saxena* 1529, 5616, 5679; *Singh* 4387, 6785; *Khotele* 6035. Local name: *Silphara, Chirima, Mallod Kusir.*

Cynoglossum lanceolatum Forsk.
Bailadilla, Bijapur, Bodegaon, Bhainsgaon, Darbha, Kondagaon. *Khotele* 2093, 3152, 5296; *Khotele* & *Shukla* 5359; *Singh* 2216, 2266. Local name: *Latkana, Choti likanda.*

Heliotropium marifolium Retz.
Bade Bacheli. *Khotele* 6056.

H. ovalifolium Forsk.
Jagdalpur. *Khotele* 11531.

H. strigosum Willd.
Dantewada. *Khotele* 2867.

Convolvulaceae

Argyreia sericea Dalz.
Kirandul, Kanker, Korar, Bhiragaon, Darbha, Bispur. *Singh* 2573; *Khotele* 2025, 3095; *Khotele* & *Shukla* 7277, 7346. Local name: *Bhainsa Kand.*

Erycibe paniculata Roxb.
Dantewada. *Khotele* 6029.

Evolvulus alsinoides (Linn.) Linn.
Fairly common. *Singh* 6681, 7099; *Khotele* 1981, 2058, 3112, 3323, 5090, 5298, 6211, 6236, 6291, 10375. Local name: *Karabuta, Bhui-Chirayata, Phulka, Konijorabhaji.*

Ipomoea batata (Linn.) Linn.
Dantewada, Korar: escape. *Khotele* 2870, 8401.

Ipomoea cairica (Linn.) Sweet
Geedam. *Singh* 4354. Local name: *Komelalki.*

I. eriocarpa R. Br.
Kirandul, Bhainsgaon. *Singh* 2595; *Khotele* 3164. Local name: *Phulodari.*

I. hederifolia Linn.
Syn. *I. coccinea* C.B. Cl. non Linn.
Korar, Jagdalpur. *Khotele* 8430; *Khotele* & *Shukla* 6469.

I. nil (Linn.) Roth
Kutumsar. *Khotele* & *Shukla* 7384.

I. obscura Ker-Gawl.
Bhanupratappur, Badedongar, Darbha. *Khotele* 8538, 8595, 9566, 11527.

Merremia hederacea (Burm. f.) Hall. f.
Syn. *Ipomoea chryseides* Ker-Gawl.
Sukma. *Saxena* 5690.

M. tridentata (Linn.) Hall. f.
Tirathgarh, Kanker, Dudhawa. *Saxena* 1551, 5499; *Khotele* 2023.

Rivea hypocrateriformis Choisy
Kondagaon. *Saxena* & *Khotele* 1865. Local name: *Garyparh.*

Solanaceae

Datura metel Linn.
Darbha. *Khotele* 8774.

Physalis minima Linn.
Jagdalpur. *Khotele* 2803, 9515.

Solanum surattense Burm. f.
Dudhawa, Bhopalpatnam. *Saxena* 1540; *Khotele* 8775.

Scrophulariaceae

Antirrhinum orontium Linn.
Kondagaon. *Khotele* 3083.

Limnophila aromatica (Lamk.) Merr.
Darbha. *Khotele* 9584.

Lindernia anagallis (Burm. f.) Pennell
Budra, Sukma, Dhondai, Karrakosa, Bhiragaon, Darbha, Dantewada, Geedam. *Saxena* 1629, 5641, 5643, 5645; *Singh* 7091; *Khotele* 3118, 4054, 6036, 8763, 9574. Local name: *Pidkushir.*

* *L. cordifolia* (Colsm.) Merr.
Tirathgarh, Darbha, Dantewada. *Saxena* 1464, 5448; *Khotele* 6045, 9571.

* *L. hirsuta* (Benth.) Wettst.
Dantewada. *Khotele* 6025.

L. pusilla (Willd.) Schlecht.
Syn. *L. hirta* (Cham. & Schl.) Mukherjee
Keshkal, Badebacheli. *Saxena* 1562; *Khotele* 6062.

L. multiflora (Roxb.) Mukherjee
Bastar, Tongpal. *Singh* 7006, 7130.

L. nummularifolia (D. Don) Wettst.
Bispur. *Khotele* & *Shukla* 7371; *Saxena* 1813.

L. parviflora (Roxb.) Haines
Dhondai, Sukma, Maita. *Khotele* 4054, 10364; *Singh* 7153.

OROBANCHACEAE

Orobanche aegyptiaca Pers.
Chhotedongar. *Khotele* 5238 A.

LENTIBULARIACEAE

Utricularia aurea Lour.
Syn. *U. flexuosa* Vahl
Sonpur, Dantewada. *Saxena* 1211; *Khotele* 5209.

** *U. graminifolia* Vahl
Tirathgarh. *Saxena* 1480, 5481.

BIGNONIACEAE

Heterophragma roxburghii DC.
Allapalli. *Khotele* 9373.

ACANTHACEAE

Adhatoda vasica Nees
Badedongar, Pharasgaon, Jagdalpur. *Khotele* 8540; *Saxena* 1472.

Andrographis echioides (Linn.) Nees
Bijapur, Sambalpur, Kanker, Darbha, Bispur. *Singh* 2360; *Khotele* 1999, 3026, 10221, 17367.

Dicliptera bupleuroides Nees
Narainpur, Bhanupratappur. *Khotele* 5052, 8590.

Dipteracanthus beddomei (C.B. Cl.) Sant.
Kameli, Kutumsar. *Khotele* 8013; *Khotele* & *Shukla* 6451, 7300.

D. prostratus (Poir.) Nees
Bailadilla. *Singh* 2284.

D. suffruticosa (Roxb.) Voight
Tongpal. *Khotele* 6583.

Dystoriste erecta (Burm. f.) O. Ktze.
Kutumsar. *Panigrahi* & *Arora* 1165 (BSA).

Justicia diffusa Willd.
Sukma, Kanker, Antagarh, Keshkal. *Singh* 7081; *Khotele* 1994, 4003; *Khotele* & *Shukla* 5376. Local name: *Bapadai Ghachh*.

J. glauca Rottb.
Golapatti, Kanker, Domkosa, Bhanupratappur, Sukma. *Khotele* 2021, 8584, 10367; *Singh* 7140.

Lepidagathis cristata Willd.
Tirathgarh, Antagarh, Bhanupratappur, Darbha. *Saxena* 5508; *Khotele* 3381, 3395, 8585, 10202.

Rungia repens Nees
Tongpal. *Singh* 7052.

* *Staurogyne glauca* (Nees) O. Ktze.
Darbha. *Saxena* 5406.

Strobilanthes edgeworthii Nees
Bhaisgaon, Darbha. *Khotele* 8485, 10204.

* *Synnema barbigera* O. Ktze.
Syn. *Cardanthera balsamica* Benth. ex C.B. Cl.
Dantewada, Nelsanar. *Saxena* 1172; *Singh* 4362. Local name: *Latbhaji*.

VERBENACEAE

Callicarpa macrophylla Vahl.
Bhansi, Bailadilla, Basanpur, Dantewada, Badebacheli. *Saxena* 1252; *Singh* 6652; *Khotele* 6077, 8027.

Clerodendrum phlomoides Linn. f.
Awapalli. *Khotele* 8708.

C. viscosum Vent
Syn. *C. infortunatum* auct. non Linn.
Sukma, Chhotedongar. *Saxena* 1680; *Khotele* 5220, 5240.

Duranta repens Linn.
Darbha, Amravati, *Khotele* 6267, 6406, 10207.

Premna barbata Wall. ex Schauer
Keshkal. *Saxena* & *Khotele* 17877.

Pygmacopremna herbacea (Roxb.) Moldenke
Syn. *Premna herbacea* Roxb.
Budra, Jherandalli-Bhanupratappur, Kondagaon. *Saxena* 1249; *Khotele* s.n.

Vitex leucoxylon Linn. f.
Tirathgarh, Manikpur, Badebacheli, Awapalli. *Saxena* 1491, 1596, 5484; *Khotele* 6057, 9396.

V. negundo Linn.
Awapalli. *Khotele* 9387.

Labiatae

* *Dysophylla verticillata* Benth.
Dantewada. *Singh* 2490.

Leucas aspera (Willd.) Spreng.
Geedam. *Khotele* 10253.

L. cephalotes (Roth) Spreng.
Tongpal. *Singh* 7016. Local name: *Bhui Kumra.*

L. lavandulaefolia Rees
Keshkal, Darbha, Govindpur, Jagdalpur, Chhotedongar, Tongpal Dumarpadar. *Saxena* 1582, 5463; *Saxena & Khotele* 1691; *Khotele* 4317, 3479, 5221, 5394, 6569. Local name: *Banbhuhari, Gubi.*

L. nutans Spreng.
Bhansi. *Saxena* 1440.

Micromeria biflora Benth.
Bailadilla, Purva Kameli. *Singh* 4306, 4336; *Khotele* 9080. Local name: *Bantili, Hariabuta.*

Ocimum americanum Linn.
Budra, Sukma, Kirandul, Bhanupratappur, Darbha. *Saxena* 1641, 5404, 5682; *Khotele* 8098, 8548, 10240; *Singh* 2256, 6692. Local name: *Vantulsi.*

O. basilicum Linn.
Kanker, Jagdalpur. *Khotele* 3493, 8447.

O. sanctum Linn.
Bispur, Dudhawa. *Saxena* 1561; *Khotele* 7345.

** *Platystoma africanum* Beauv.
Keshkal. *Khotele* 7292.

Nyctaginaceae

Mirabilis jalapa Linn.
Tongpal, Bijapur. *Singh* 2203, 7022. Local name: *Dhudya ghil.*

Amaranthaceae

Achyranthes bidentata Bl.
Bispur. *Khotele* 10309

Aerva monsoniae (Linn. f.) Mast.
Bhopalpatnam, Kanker, Antagarh. *Khotele* 1991, 4015, 8780.

Allmania nodiflora R. Br.
Amraoti. *Khotele* 6254.

Amaranthus blitum Linn. var. *oleracea* Hk. f.
Kutumsar. *Panigrahi & Arora* 1176 (BSA).

A. caudatus Linn.
Sukma. *Khotele* 10357.

A. spinosus Linn.
Common in waste lands. *Khotele* 2802, 5279, 6412, 8748.

A. tricolor Linn.
Bhainsgaon-Narainpur. *Khotele* 3148.

A. virdis Linn.
Nelsanar. *Singh* 4363.

Deeringia amaranthoides (Lam.) Merr.
Kondagaon. *Khotele* 6213.

Gomphrena celosioides Mast.
Dantewada, Tongpal. *Saxena* 1232; *Singh* 2300; *Khotele* 6413, 6576.

** *Psilotrichum trichotomum* Bl.
Bijapur, Dornapal, Godantari-Kondagaon. *Singh* 2215, 7097; *Khotele* 5292.

Polygonaceae

* *Polygonum rottleri* Roth
Syn. *P. flaccidum* Meissn.
Amabeda. *Khotele* 8460. Local name: *Bas.*

P. serrulatum Lagasc.
Bispur. *Khotele* 10342.

P. stagninum Buch.-Ham.
Kirandul, Nelsnar, Narainpur. *Singh* 4211, 4378; *Khotele* 3124, 8460. Local name: *Magarlata, Urnilua, Kiker Kushir.*

P. tomentosum Willd.
Dantewada, Sangam-Bhopalpatnam, Jagdalpur. *Khotele* 8728, 11518; *Singh* 2489.

Lauraceae

Litsea glutinosa (Lour.) C.B. Robins.
Kangernala, Awapalli. *Khotele* 9400.

Euphorbiaceae

Acalypha indica Linn.

Kristaram. *Singh* 7135.

Bridelia montana Willd.
Sukma. *Khotele* 10363.

Chrozophora prostrata Dalz.
Sukma. *Saxena* 5649.

** *Cleistanthus patulus* Muell.-Arg.
Purvakameli, Bailadilla. *Khotele* 9013, 9058, 9062.

Euphorbia hypericifolia Linn.
Dantewada, Bhansi, Tongpal. *Khotele* 2838, 7003; *Singh* 6913. Local name: *Barpad Kushir.*

E. prostrata Ait.
Darbha, Dudhawa. *Saxena* 1527; *Saxena & Khotele* 1680, 1683; *Khoele & Shukla* 7244. Local name: *Dudhi.*

Jatropha curcas Linn.
Budra, Tirathgarh. *Saxena* 1626, 5474. Local name: *Ranijad, Bajranga.*

Phyllanthus asperulatus Hatch.
Syn. *P. fraternus* Webst.
Bhansi, Bispur. *Saxena* 1245, 1348; *Khotele & Shukla* 7303.

P. urinaria Linn.
Bijapur, Kutumsar, Bailadilla, Jagdalpur. *Khotele* 2801, 6082; *Singh* 2213; *Khotele & Shukla* 6427.

Ricinus communis Linn.
Keshkal, Kirandul, Bhanupratappur, Kosalnar-Kondagaon. *Saxena* 1362; *Khotele* 3439, 5277, 8827.

Utricaceae

Laportea interrupta (Linn.) Chew.
Syn. *Fleurya interrupta* (Linn.) Wt.
Narainpur, Keshkal, Konta. *Khotele* 3141; *Khotele & Shukla* 5370; *Singh* 7192.

Pilea microphylla Liebm.
Kondagaon, Jagdalpur. *Khotele* 2812, 3087.

Pouzolzia auriculata Wight
Keshkal. *Saxena & Khotele* 1806; *Khotele* 5373.

Moraceae

Ficus rumphii Bl.
Kosalnar-Kondagaon. *Khotele* 5273. Local name: *Jodi.*

F. tomentosa Roxb.
Mohpal-Pharasgaon. *Khotele* 8533.

Morus indica Linn.
Keshkal. *Khotele & Shukla* 5388.

Salicaceae

Salix tetrasperma Roxb.
Sukma, Korar, Geedam. *Saxena* 5642; *Khotele* 8489, 10254. Local name: *Nained.*

Ceratophyllaceae

Ceratophyllum demersum Linn.
Manikpur, Kutru, Bhairamgarh. *Saxena* 1605; *Khotele* 9330. Local name: *Jalbi.* ..

Hydrocharitaceae

Hydrilla verticillata (Linn. f.) Royle
Bhiragaon. *Khotele* 3103.

Orchidaceae

Acampe praemorsa (Roxb.) Blatt. & McCann
Syn. *Saccolobium wightianum* Hk. f.
Kirandul, Tirathgarh. *Saxena* 1459; *Khotele* 8096.

Eulophia mackinonii Duthie
Kondagaon. *Saxena & Khotele* 1855.

Habenaria marginata Colebr.
Bhainsgaon. *Khotele* 3177.

Zingiberaceae

Curcuma angustifolia Roxb.
Darbha, Keshkal. *Saxena* 5444; *Saxena & Khotele* 1809. Local name: *Tikhur.*

C. aromatica Salisb.
Kirandul. *Khotele* 8080.

** *C. pseudomontana* Grah.
Amraoti, Kameli-Dantewada. *Khotele* 2899, 6261. Local name: *Sirondi.*

Globba racemosa Sm.
Bailadilla, Tongpal. *Singh* 6610; *Khotele* 6562, 8077.

** *Zingiber capitatum* Roxb.
Bhopalpatnam, Antagarh, Bailadilla. *Singh* 2196, 4282; *Khotele* 3359. Local name: *Gerkan.*

Z. rubens Rosc.
Bhainsgaon, Korar. *Khotele* 8493.

Amaryllidaceae

Agave americana Linn.
Kondagaon. *Saxena* & *Khotele* 1831. Local name: *Rambans, Khetki.*

Taccaceae

Tacca leontopetaloides (Linn.) O. Ktze.
Kondagaon, Bijapur. *Saxena* & *Khotele* 1853, 2383. Local name: *Dhongri, dhai.*

Dioscoreaceae

Dioscorea alata Linn.
Narainpur. *Khotele* 4048. Local name: *Bhainsd-hate.*

** *D. wallichii* Hk. f.
Dantewada. *Saxena* 1209.

Liliaceae

Asparagus gracilis Royle
Korar, Kutumsar. *Khotele* 2062; *Khotele* & *Shukla* 6421.

Chlorophytum laxum R. Br.
Tirathgarh. *Saxena* & *Khotele* 1880.

Iphigenia indica (Linn.) A. Gray
Antagarh, Keshkal. *Khotele* 3380, 5346.

Urginea indica (Roxb.) Kunth
Dantewada, Chhotedongar, Amraoti. *Saxena* 1226; *Khotele* 5227; 6272.

Pontederaceae

Monochoria vaginalis Presl.
Kondagaon: aquatic. *Saxena* & *Khotele* 1871.

Commelinaceae

Commelina forskalii Vahl
Jagdalpur. *Khotele* 3488.

* *Murdannia vaginatum* (Linn.) Bruck.
Dumarpak. *Khotele* 7211.

Juncaceae

Juncus prismatocarpus R. Br.
Tirathgarh. *Saxena* 5507.

Araceae

Arisaema tortuosum Schott
Keshkal, Kutumsar, Geedam, Dantewada, Kirandul. *Khotele* 1798; *Khotele* & *Shukla* 5327, 7391; *Singh* 2591, 6925, 6770. Local name: *Dheskand, Baggujri.*

Remusatia vivipara (Lodd.) Schult.
Kirandul, Keshkal, Tirathgarh, Bailadilla. *Saxena* 1397; *Saxena* & *Khotele* 1810; *Khotele* 3205, 8058.

Theriophorum minutum Engl.
Tirathgarh, Kutumsar. *Saxena* & *Khotele* 1848; *Khotele* & *Shukla* 6422.

Alismaceae

Butomopsis lanceolata Kunth.
Dantewada, Darbha, Bhairamgarh. *Khotele* 9322, 9577; *Singh* 2478.

Saggitaria guayanensis H.B.K.
Konta: aquatic. *Singh* 7106.

Potamogetonaceae

* *Potamogeton javanicus* Hassk.
Bhaisgaon, Tirathgarh. *Saxena* 5488; *Khotele* 5100.

P. indicus Roxb.
Syn. *P. nodosus* Poir.
Bhairamgarh, Manikpur, Budra. *Saxena* 1604, 3424; *Khotele* 9375.

Aponogetonaceae

* *Aponogeton natans* (Linn.) Engl. & Krause
Syn. *A. monostachyus* Linn. f. ("*monostachyon*")
Tongpal. *Singh* 7001.

Cyperaceae

Bulbostylis barbata (Rottb.) C.B. Cl.
Dantewada. *Khotele* 2878.

B. capillaris Kunth.
Dantewada. *Khotele* 2879.

Cyperus amabilis Vahl
Kondagaon. *Khotele* 3111.

C. digitatus Roxb.
Bhairagaon. *Khotele* 3104.

C. exaltatus Retz.
Kanker, Jharandelli, Tongpal. *Khotele* 2030, 3064; *Singh* 7033. Local name: *Bidya Tonda.*

C. melanosperma (Nees) Suringar
Bacheli, Kirandul path. *Singh* 2521.

C. sanguinolentus Vahl
Darbha, Bispur. *Khotele* & *Shukla* 9588, 10343.

C. squarrosus Linn.
Darbha. *Khotele* & *Shukla* 7257.

C. tenuispica Steud.
Syn. *C. flavidus* auct. non Retz. sensu C.B. Cl. in Fl. Brit. Ind.

Sukma, Geedam, Dantewada, Jagdalpur. *Saxena* 1178, 1181, 1184.

C. triceps (Rottb.) Engl.
Geedam, Amraoti, Kondagaon, Bengpal. *Khotele* 2877, 6279, 6203, 10354; *Singh* 2419.

Elaeocharis congesta D. Don
Darbha. *Khotele* 9564.

Fimbristylis argentea Vahl
Kutru-Bhairongarh. *Khotele* 9337.

F. littoralis Gaud.
Syn. *F. miliacea sensu* C.B. Cl. in Fl. Brit. Ind.

Bodagaon, Geedam, Dumarpadav, Darbha, Bijapur, Kirandul. *Khotele* 3013, 9546, 11502; *Khotele* & *Shukla* 7217, 7263; *Singh* 2357, 2526, 4339. Local name: *Kondibuti, Narhaghas.*

Fuirena ciliaris (Linn.) Roxb.
Konta. *Saxena* 5704.

Rhynchospora longisetis R. Br.
Kanker, Konta. *Khotele* 2067; *Singh* 1779.

Scirpus erectus Poir.
Korar. *Khotele* 8442.

S. squarrosus Linn.
Bhopalpatnam, Darbha, Geedam, Sukma. *Khotele* 4337, 5085, 8762, 7259, 9365, 10277; *Khotele* & *Shukla* 10365.

S. supinus Linn.
Geedam. *Khotele* 10273.

Scleria caricina (R. Br.) Benth.
Bispur. *Khotele* 10325.

Gramineae

Alloterospsis cimicina (Linn.) Stapf
Dantewada, Konta, Geedam, Darbha, Keshkal. *Khotele* 2888, 9527; *Singh* 2237, 7173; *Khotele* & *Shukla* 5331, 7261.

Bothriochloa glabra (Roxb.) A. Camus
Antagarh. *Khotele* 3384.

B. odorata (Lisboa) A. Camus
Antagarh. *Khotele* 3396.

Brachiaria reptans (Linn.) Gard. et C.E. Hubb.
Kutru, Bhairongarh, Kameli, Dantewada. *Khotele* 2824, 2893, 9338.

Chloris dolichostachya Lagasc.
Sonpur. *Khotele* 5201.

Dichanthium aristatum (Poir.) C.E. Hubb.
Dantewada, Bhairamgarh. *Saxena* 1233; *Khotele* 9339.

Digitaria granularis (Trin.) Henr.
Darbha, Tirathgarh, Bispur, Bhaisgaon, Narainpur. *Saxena* 1896; *Khotele* & *Shukla* 7262, 7380; *Khotele* 3176.

D. longifolia (Retz.) Pers.
Bhopalpatnam. *Khotele* 8766.

Eragrostiella bifaria Wight ex Steud.
Keshkal, Korar, Dantewada. *Khotele* 2006; *Khotele* & *Shukla* 5358; *Shukla* 5356.

E. brachyphylla (Stapf) Bor
Tongpal, Bailadilla. *Khotele* 6572; *Singh* 6603.

Eragrostis tenuifolia Hochst. ex Steud.
Keshkal. *Saxena* 1698.

E. viscosa (Retz.) Trin.
Chhotedongar, Keshkal, Manikpur, Bailadilla, Kondagaon. *Saxena* 1607; *Singh* 4290; *Khotele* 3419, 5215, 5282.

Eulalia trispicata (Schult.) Henr.
Kirandul. *Singh* 2559. Local name: *Bhanaghas.*

Hackelochloa granularis (Linn.) O. Ktze.
Marta, Keshkal, Kutumsar, Bhanupratappur. Korar, Bispur. *Singh* 2377, 7171; *Khotele* & *Shukla* 5360, 6438; *Khotele* 2003, 3061.

Isachne globosa (Thunb.) O. Ktze.
Antagarh, Kirandul, Bhanupratappur, Geedam, Bispur. *Khotele* 10391, 10392, 10322, 11310, 11509, 3048, 3555; *Singh* 2522. Local name: *Bindu Rodaghas.*

Ischaemum nilagiricum Hack.
Sonpur. *Khotele* 5070.

Mnesithea laevis (Retz.) Kunth
Keshkal, Bastar. *Khotele* & *Shukla* 7202; *Khotele* 6230.

Panicum notatum Retz.
Keshkal, Narainpur, Kirandul, Bailadilla. *Khotele*

3156, 3476, 4042; *Singh* 2522, 4308. Local name: *Chhinghas*.

P. paludosum Roxb.
Keshkal. *Khotele & Shukla* 7229.

P. psilopodium Trin.
Bispur, Tongpal, Bhairamgarh, Jagdalpur, Kameli, Bailadilla. *Khotele* 3159, 6300, 6575, 8010; *Khotele & Shukla* 7316; *Singh* 4291. Local name: *Nan Kousra*.

P. sumattrense Roth
Jagdalpur, Geedam, Bispur, Bailadilla, Narainpur, Bhanupratappur. *Khotele* 3489, 5095, 8092, 8552, 10262; *Khotele & Shukla* 7332; *Singh* 4324; *Khotele* 3489. Local name: *Koshra, Kodoghas*.

Paspalum orbiculare Forst.
Tirathgarh, Bastar. *Khotele* 8559, 8589.

Pseudopogonatherum contortum (Brongn.) A. Camus
Kirandul, Korar, Budra. *Singh* 2561; *Khotele* 3352, 3432. Local name: *Bhirbhasighas*.

Setaria verticellata (Linn.) P. Beauv.
Kutumsar. *Khotele & Shukla* 7388.

Sorghum cernnum Host.
Darbha. *Khotele* 10242.

Sporobolus indicus auct. non (Linn.) R. Br.
Amraoti. *Khotele* 6246.

S. tenuissimus (Schrank) O. Ktze.
Korar, Keshkal. *Khotele* 2064; *Khotele & Shukla* 5361.

Aspidiaceae

* *Cyclosorus parasiticus* (Linn.) Tardein ex Tardien & C. Chr.
Syn. *Dryopteris parasitica* (Linn.) O. Ktze.
Bhansi, Kirandul. *Saxena* 1343; *Singh* 2544.

Aspleniaceae

** *Asplenium dalhausiae* Hook.
Syn. *Ceterach dalhausiae* (Hook.) C. Chr.
Bailadilla. *Singh* 4294.

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Some observations on the ecology of the land snail *Ariophanta maderaspatana* (Gray)[1]

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(*With two photographs in a plate*)

Introduction

The terrestrial pulmonates to which *Ariophanta maderaspatana* belongs inhabit open woodlands, parks, gardens, and similar habitats where humid niches occur.

The species appears to be widely distributed in South India and is also recorded along the Western Ghats in places like Bombay, Matheran etc. In Bombay specimens of *Ariophanta* could be collected from gardens on and near about Malabar Hill and especially from the Borivli National Park, 38 km north of Bombay. Along with *Ariophanta maderaspatana* specimens of *A. bajadera* and *A. laevipes* also could be collected though not in large numbers.

The Environment

The hills in the National Park, 76.11 metres or more in height are covered with moist deciduous forest, where *Pterocarpus marsupium*, *Bombax malabaricum* (silk cotton), *Erythrina indica* (Indian coral tree), *Alstonia scholaris* (Devil tree or Shaitan), *Grewia tiliifolia* (Phalsa), *Schleichera trijuga* (Ceylon Oak) and *Butea frondosa* (Flame of the Forest) are common.

The Gandhi Memorial or Pavilion hill situated near the entrance of the park is about 76.11 metres high and is covered with plants like *Holarrhena antidysenterica* (Kurchi), *Wrightia tinctoria* (Kala Kurchi) and *Casearia tomentosa*. The sides of the road from the entrance of the park towards Gandhi Memorial Hill, have trees like *Bauhinia variegata* (Kachnar), *Mangifera indica* (Mango), *Tectona grandis* (Teak) and grass and herbs interspersed with tree seedlings. The area near the road especially on the left side of the road towards Gandhi Hill abounds in *Ariophanta maderaspatana*. Comparatively few snails were collected from the right side of the road, probably due to the fact that the left side of the road is more shady and moist than the right. The snail normally prefers such a habitat. Some grasses belonging to the genera, *Echinochloa*, *Leptochloa*, *Fimbrystylis* and *Cyperus* were also commonly noticed in this area, especially in flooded area. Numerous fungi and lichens also grow on this moist, humus substratum, preferred by *Ariophanta* and other land snails.

Ariophanta maderaspatana and the other two species *A. bajadera* and *A. laevipes* and

[1] Accepted October 1973.

slugs are never found close to water but rather away from them where, the soil is always moist and atmosphere humid. In and around these ponds and streams in the Park are found other gastropods like *Lymnaea, Tropicarbis, Planorbis, Vivipara* and *Pila*.

Physical Properties of the Soil:

The soil of the National Park varies from few inches deep gravely soil on the top of the rocks to about five to six feet deep medium brown to black soil in the lowland. The shallow soil is fit only for the growth of grasses. At places where the soil is deep brown in colour and covered with large trees, it is generally rich in humus and is preferred by the snail. In places where the soil is loamy or reddish and somewhat sandy snails rarely occur.

Water and air capacity of the soil is also important both from the point of view of growth of vegetation as well as from the view point of hibernation or aestivation of the snail.

It has been shown (Das 1950) that with decrease of the water content of the soil due to change in season there is a gradual increase in air content. The large quantity of humus and the shade afforded by the large trees growing in the deep brown soil prevent much evaporation of water from the soil. The soil in grassland areas and the black loamy soil are comparatively poor in their water and air capacity, whereas, the deep brown soil on which large trees grow, has a better water and air retaining capacity (Das, op. cit.).

CHEMICAL NATURE OF THE SOIL:

Soil samples from a depth of 6 inches to 9 inches were collected from number of spots uniformly distributed and where the animals were found in abundance. Standard analytical methods, (Hesse 1971; Piper 1944) were followed to determine the nature of the soil. The results of the laboratory analysis of the soil are given in Table 1.

TABLE 1

SOIL ANALYSIS

S. No.	Parameter studied	Results
1.	Moisture	2.8%
2.	pH	7.6
3.	Total Soluble solids	4.2%
4.	Chlorides	0.151%
5.	Calcium*	1.736%
6.	Loss on Ignition (organic matter)	13.9%

* Common red earth used for gardening was also tested for its calcium content, which was found to be less than 0.5%.

CLIMATIC FACTORS:

1) *Temperature*:

Table 2, gives the monthly average of temperature recorded at Santacruz, Bombay for the last 3 years. The temperature does not vary much from month to month and fluctuations which occur from day to day are negligible.

2) *Rainfall*:

Rainfall data recorded at the Meteorological station, Santacruz, was obtained from the Colaba Observatory. The monthly averages of the rainfall over a period of 3 years is given in Table 2.

The rainy season usually commences by the beginning of June and ends by middle of October or a little earlier. The early showers are gentle and wet the soil only to a limited depth, and give the natural vegetation, a great stimulus for vigorous growth. Very young forms of the snail are seen crawling on rocks and on grassland during this period.

From December to May, the conditions are

dry. Most of the seasonal ground vegetation starts wilting during this period and thus adds a large amount of organic matter to the surface. By the end of November before the ground becomes very dry, the snail enters the soil for aestivation and finally disappears from view.

3) *Humidity*:

The moisture present in the atmosphere of an animal habitat depends largely on the rainfall, temperature and wind. Humidity thus tends to remain fairly constant in patches of thick vegetation and regions of deep shade.

TABLE 2

1969-1971

MONTHLY AVERAGES OF THE TEMPERATURE, RELATIVE HUMIDITY AND RAINFALL

	Temperature Max. °C	Temperature Min. °C	Humidity %	Rainfall (mm)
January	30.6	16.2	57.0	000.00
February	30.7	18.6	66.0	000.00
March	32.6	20.7	62.0	000.00
April	33.4	24.3	66.6	000.00
May	33.5	26.6	69.6	000.00
June	31.4	25.5	83.6	563.5
July	30.4	24.9	87.3	587.5
August	29.3	24.5	87.6	584.4
September	29.7	24.2	86.6	377.0
October	32.9	22.8	73.6	232.3
November	33.7	20.0	54.3	005.6
December	32.4	17.6	53.3	000.06

Table 2 for mean monthly relative humidity over the period of 3 years shows that humidity ranges from 83.6 to 73.6 per cent in the period June to October, while from November to May, it ranges from 54.3 to 69.6 per cent.

DISCUSSION

1) *Substratum*:

Ariophanta maderaspatana lives successfully either in loose, rich, reddish brown soil containing particles of free chalk, or on rocks in the vicinity of the soil, provided they are overgrown with some grass or moss. Occasionally the animals are seen on rocky slopes near flowing streams.

Hesse *et al.* (1951), observed that land snails with calcareous shells are especially abundant on soil rich in lime. A certain amount of calcium is of course present everywhere where animals and plants live and as has been mentioned by Hyman (1967), Boycott (1934), there is no clear cut division between calcareous and non-calcareous soil. "As it happens, however, the amount of $CaCO_3$ in soil (about 0.5%) which gives a perceptible frizzle with acid in the field seems to mark the level at which earth begins to be 'calcareous' from snail's point of view". (Boycott, op. cit.).

The soil of Borivli National Park, contains about 1.7 per cent calcium. Calcium in the form of $CaCO_3$ is essential for the secretion of

the shell. This calcium is obtained by the animal only through its food which is normally in the form of humus, fungi and even fresh leaves of plants growing in the soil.

This was confirmed by a few observations made in the laboratory. For this purpose, young snails were allowed to grow in the laboratory on a substratum consisting of normal red earth whose calcium content is usually less than 0.5 per cent. The snails were fed on bean and pea seedlings grown in the same soil. As a control experiment, snails almost of the same size as used in the trial experiment, were allowed to grow in the soil obtained from the National Park. These snails were fed on fresh leaves and humus obtained from the same area.

Fortnightly observations regarding growth of the animal (size of shell) and fragility of the shell were made for a period of four months. Simple handling was enough to know whether the shell was fragile or not.

It was observed that in the case of animals grown in red earth, the growth is rather slow, and the shell weaker and more fragile than in the case of snails grown in the control experiment.

The reason for the occurrence of *Ariophanta* in the calcareous soil thus becomes quite apparent. It must however, be pointed out, that snails can obtain $CaCO_3$ required for the shell secretion only through the food i.e. plant leaves, humus and fungi. Boycott (1934) and Robertson (1941) have shown that the thickness and weight of the shell is directly dependent on the amount of calcium.

2) *Habitat*:

For a terrestrial pulmonate such as *A. maderaspatana* the shelter must always be damp and provide nooks and crannies into which it can retire in times of stress and into which it can escape drought and cold. Trampling by men and animals makes the ground firm and destroys its surface porosity, a condition naturally harmful. *Ariophanta* therefore inhabits grounds which are normally away from such influences and is often found near the base of the trees (Photo. 1 and 2) where the soil is moist, soft and rich in nutrients because of the thick layer of humus. Areas underneath large stones, logs of wood and fallen twigs are reservoirs of dampness and provide safe retreat.

3) *Moisture*:

The dampness of the habitat determines the amount of time a mollusc can spend in feeding and breeding (Boycott 1934). It is well known that snails and slugs walk on a film of thin mucus and use up water in the process. The loss of water is said to be restored, when the animals eat or drink (Boycott 1934). There is also a loss of water from the skin, which varies with the humidity of the air and once a snail is dehydrated beyond a certain threshold it becomes immobilised and finally dies. *Ariophanta* is therefore seen walking around its habitat at night or in the early morning when there is dew or in the wet weather. The soil covered by some grasses and other seasonal herbs and shaded by the overlying tree crowns, remains moist for number of days even after the monsoon and forms an ideal habitat for the snail till about middle of November.

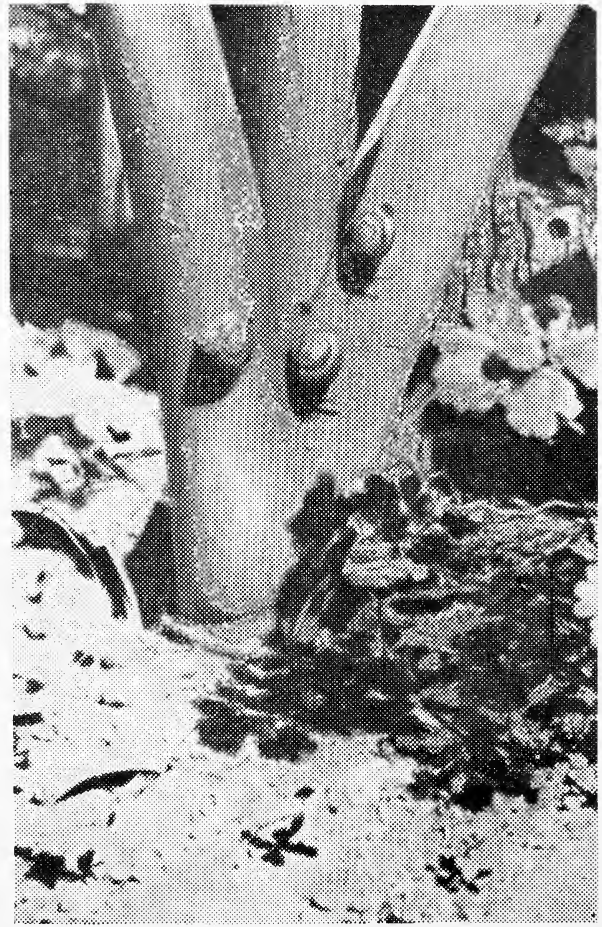
4) *pH of the Soil*:

Table 1, shows that the pH of the soil inhabited by *A. maderaspatana* is about 7.6. This is in conformity with the calcareous nature of the soil. During its normal life, barring aestivation, the animal rarely burrows in the soil and thus is unlikely to be affected by the change in pH.

It has been reported (Burch 1955) that land snails are most abundant at pH 6.3 to 6.7. However, *Ariophanta* seems to favour a pH which is slightly on the alkaline side.

1

Fig. 1. Photograph showing the natural habitat of *Ariophanta maderaspatana.* (2 animals encircled. Black arrow showing the epiphragm).



2

Fig. 2. Photograph showing the snails climbing up a plant to avoid drowning during rains.

5) *Rainfall and Humidity*:

The premonsoon showers towards the end of May bring out the aestivating snails. The subsequent monsoon from June to September besides keeping the soil moist during the period of animal's life, causes a luxuriant growth of many herbs, grasses and seedlings in the shade of the trees. Such a vegetation besides providing fresh leaves to the animals, ultimately adds to the humus on the substratum.

Even though rains provide a favourable background as far as moisture and food of the animal are concerned, excess of water on the substratum sometimes caused by flooding during this season, is harmful. If a snail is accidentally caught in such a flood, the pulmonary aperture (pneumostome) gets blocked and the animal gets asphyxiated and finally drowns. Further, if a snail falls in water its mucus becomes diluted and the animal is unable to crawl out. *Ariophanta,* therefore, usually seeks shelter from heavy rains. When it is raining for a sufficiently long time, the animals are often found climbing up the trees (Photo. 2) in the neighbourhood, to avoid drowning.

It has been observed that humidity plays an invaluable role in breeding habits of this snail. This can be seen from the fact that during the period of high humidity (June-October) (Table 2), the species thrives better, grows faster and breeds twice. As soon as the relative humidity goes down from November onwards, the animal stops breeding and undergoes aestivation.

6) *Light and Temperature*:

Observations show that *Ariophanta maderaspatana* rarely moves and feeds in the open after 8 o'clock in the morning when there is bright sunlight.

Table 2, shows that the range of maximum temperature for the area is 29.3°C-33.7°C and of the minimum temperature 26.6°C to 16.2°C. The proximity of the sea and the presence of water vapour in the air makes the climate equable even during winter. The temperature of the area thus does not seem to have much influence on the activity or abundance of the snail. The animal however avoids direct exposure to heat and light and normally frequents shady places where the temperature is generally low.

Food and Feeding Habits

These were studied by field observations as well as by studying the gut contents. Basically *Ariophanta maderaspatana,* can be considered as herbivorous, though often the gut contents occasionally reveal the presence of small insects, pieces of earthworms etc. The animal normally eats decayed remains of the higher plants, fungi and some mosses. It also eats fresh leaves of most of the herbaceous plants in the area and does not appear to be particularly selective in its choice of food. In laboratory, the animals were fed on cabbage, lettuce and carrots, all of which were readily accepted. Leaves of trees are seldom eaten, primarily because of the height at which the foliage is situated. The animals though they climb such trees to seek shelter during heavy rains, were never seen to go beyond a height of 12-15 ft. Some wild plants in the area are seldom eaten by snails like *Ariophanta* possibly because of the fact that many of them are usually protected by hair, oxalate crystals or by juice which is offensive to snails (Hyman 1967).

Sometimes the snail attacks many of the ornamental plants in the park and spoils them. Mosses and algae growing on rocks and tree bases, are also not spared by the animal as can be seen from their characteristic feeding tracks. Seedlings of *Brassica indica* and *Madhuca in-*

dica seem to be relished by the snail.

The snail also appears to be fond of a particular type of grass (*Coix lacryma-jobi*). During the rainy season this grass grows in the shade of large trees like *Erythrina indica* and *Bauhinia variegata*, and the snail is therefore found in abundance near about the base of the trees (Photo. 1 and 2). Pieces of earthworms, insects etc., found in the gut contents seem to be ingested from the dead remains of these animals, mixed with the decaying vegetation. The snails were never noticed feeding on live animals. In the feeding experiments conducted in the laboratory, it was found that the animal never touched small earthworms introduced into the soil. As far as food is concerned, *A. maderaspatana* does not seem to have competition except from the other two species of *Ariophanta* and some slugs.

Enemies:

Birds seem to be the main predators of *Ariophanta* though lizards and snakes may sometimes eat the snail. The birds especially the crows hunt for snails in vegetation, grasp it by the rim of the shell aperture, carry it on to a rock or any substratum, bang it on the rock until the upper whorls break and the columella cracks and then extract the snail body which is wiped on the ground a few times and then swallowed whole. The sluggish ways, herbivorous and sometimes omnivorous eating habits make land pulmonates easy victims of many parasites. Many ciliate species are found in the digestive tract of *A. maderaspatana*. A single nematode parasite was also recorded from the digestive tract.

Human Influence:

The National Park is regularly visited by hundreds of picnic parties and other people in large numbers. These frequent visits, sometimes result in trampling of ground in which the eggs of the snails are deposited or in which young snails are aestivating. At present the snails are restricted to the hill forest on either side of the road which leads to the Gandhi Memorial Hill. Since last year, however, construction activity has started in the area around the road to Gandhi Hill. A number of trees are being cut and the vegetation growing in the shade is thus being seriously affected. A few collections were made in June and July of 1972 to find out the effect of these activities on the snail population and it seems to have been greatly affected when compared with the observations for the two years 1970 and 1971, the period of the present study.

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Birds of Goa[1]

Robert B. Grubh and Salim Ali

Very little published information is available on the bird life of Goa during its occupancy by the Portuguese. Even after independence no work appears to have been done. Therefore Shri S. S. Bhattee (Conservator of Forests, Goa, Daman & Diu) invited the Bombay Natural History Society to conduct an ornithological survey. Accordingly a team of five consisting of Shri J. D. Panday, R. J. Pimento, M. U. Mahadik and ourselves made a brief field survey for 16 days, from 27th November to 12th December 1972.

Since the survey was so brief, only a rather superficial sampling of the total area could be done. Field work was confined mainly to 3 of the more forested localities, namely Molem, Canacona and Valpoi. It consisted of recording of species by observation and collecting specimens when necessary. 150 specimens of 100 species were collected and an additional 54 species sight recorded.

The following list is obviously incomplete. It does not include many other species which must certainly occur in Goa either as residents or as migrants, and it is hoped that a further more extensive survey will be possible for the record to be completed. For lists of birds that have been recorded in the adjoining areas see, for North Kanara, Davidson, J. (1898): *JBNHS* 2 parts, Vols. 11 and 12; for Karnataka, Sálim Ali (1942-43): ibid. 5 parts. Vols. 43 and 44.

[1] Accepted December 1975.

Physiography

Goa is a tract of undulating country on the western seaboard of India, wedged between the Arabian Sea on the west and the Sahyadri range (Western Ghats) on the east. It lies between latitudes 14°53′ and 15°48′ N., and longitudes 73°45′ and 74°24′ E., and covers an area of 3370 square kilometres (Imperial Gazetteer of India Vol. 12, p. 249). The State abuts on the Savantvadi taluka of Ratnagiri district (Maharashtra) in the north, and on the Dharwar district of Karnataka on the east and south. The crest of the Sahyadri range running N–S virtually forms the entire eastern boundary. Luxuriant evergreen and semi-evergreen forests occur in deep gorges and ravines in the northeastern and southeastern portions adjoining Karnataka. Tree growth is mostly stunted on the precipitous hillsides. The rainfall in this forest zone varies between 5100 and 7600 mm per annum, all during the SW monsoon. Under the erstwhile Portuguese regime the zone of evergreens was classified as "A" class forest and far sightedly preserved "for regulation of the climate and water flow, and conservation of soil in the hill tracts." Moist-deciduous forests, mostly secondary and degraded, occur along the foothills of the Sahyadris. They were classified as the "B" type, and being more accessible were exploited, often wastefully, for commercial timber and fuel. Class "C" forests —also Moist-deciduous, but occurring around villages and habitations—were earmarked for the domestic requirements of the local popu-

lation: for agricultural purposes, firewood, leaf fodder for cattle, and for *cumeri* or shifting cultivation. Vast areas of excellent forest everywhere in Goa, especially on the higher hill slopes, have been ruined and rendered unproductive by this pernicious practice.

Wildlife

As a result of official encouragement, and even incentives, given to hunters during the Portuguese colonial administration the forests have been effectively denuded of all wildlife, especially mammals, Birds of Prey and other large birds. During a week's survey of the forested area at Molem—now hopefully established as a wildlife sanctuary—not a single large mammal was heard or seen—not even any spoor—except one Giant Squirrel (*Ratufa*). The entire Molem, Carranzol and Neterlim valleys adjoining Karnataka were completely dead though densely covered with magnificent semi-evergreen and moist-deciduous forest. Wild animals such as gaur, sambar and pig are said occasionally to stray in from across the border, from Dandeli Wildlife Sanctuary of Karnataka, and with adequate protection the Forest Department hopes to rehabilitate these and other species here. The only other wild mammal seen during the Survey was a leopard cat (*Felis bengalensis*) that had been shot anonymously and propped up in the middle of a forest road in the Canacona area!

Large areas of degraded forest at Valpoi and elsewhere have been clear felled by the Forest Department and planted with teak, rubber, eucalyptus, cocoa and cashew, and the impact of this intrusion, mostly exotics, on indigenous bird life will repay careful monitoring.

An excursion was made to the top of Vagheri in Valpoi taluka, just under 1000 m and said to be the highest hill in Goa. This was specially in order to establish whether or not the plant genus *Rubus* (brambles) and its symbiotic bird genus *Garrulax* (laughing thrushes) also occur in Goa as both do in the Kerala ranges a couple of hundred metres above this elevation. While bracken (*Pteridium* sp.) another regular member of this plant-bird association, was plentiful near the top, there was no sign of *Rubus* or *Garrulax* although otherwise the biotope seemed eminently appropriate.

Systematic list

The measurements of the specimens collected, are given in the following order: Body weight (in grams), wing length, bill, tarsus, and tail (in mm). Bill has been measured from skull. Unless otherwise stated, all the species recorded are within their known geographical range of distribution. Subspecies are given only for the birds actually collected and examined, although it is unlikely that the identity of the others would be different from those of better worked adjoining areas.

1. *Ardeola grayii* (Sykes) Pond Heron
   Noted: Molem, Canacona
2. *Bubulcus ibis* (Linnaeus) Cattle Egret
   Noted: Valpoi
3. *Elanus caeruleus* (Desfontaines) Black-winged Kite
   Noted: Maem, Molem
4. *Pernis ptilorhynchus ruficollis* Lesson Crested Honey Buzzard
   Collected: Canacona ♂ 1050 g. *c.* 440, 42 52 263.
   Dark and pale tail bands of equal breadth, and the wing-tail index less than 65 (i.e. 60).
5. *Milvus migrans* (Boddaert) Pariah Kite
   Noted in urban areas.
6. *Haliastur indus* (Boddaert) Brahminy Kite
   Noted: Maem Lake environs
7. *Accipiter badius dussumieri* (Temminck)

Shikra
Collected: Molem, Valpoi

♂ —	183	—	—	138
♀ 233 g	195	21	54	154

Elsewhere noted: Canacona

8. *Accipiter trivirgatus* (Temminck) Crested Goshawk
Noted: Molem

9. *Butastur teesa* (Franklin) White-eyed Buzzard-Eagle
Collected: Molem

♀ 450 g	305	30	67	164

Elsewhere noted: Maem Lake environs, Canacona

10. *Ictinaetus malayensis* (Temminck) Black Eagle
Noted: Canacona

11. *Gyps bengalensis* (Gmelin) Whitebacked Vulture
Noted: Canacona

12. *Spilornis cheela melanotis* (Jerdon) Peninsular Serpent Eagle
Collected: Molem

♂ 1200 g	416	42	101	258

13. *Pandion haliaetus* (Linnaeus) Osprey
Noted: Canacona

14. *Falco peregrinus peregrinator* Sundevall Shahin Falcon
Noted: Molem

15. *Falco tinnunculus interstinctus* McClelland Kestrel
Collected: Molem

♂ 150 g	259	21	42	171

Elsewhere noted: Canacona

Although the specimen is in subadult plumage it is paler than other subspecies in subadult plumage.

16. *Coturnix coturnix* (Linnaeus) Grey Quail
Noted: Valpoi

17. *Galloperdix spadicea* (Gmelin) Red Spurfowl
Noted: Various localities

18. *Gallus sonneratii* Temminck
Grey Junglefowl
Noted: Molem, Canacona

19. *Turnix suscitator* (Gmelin) Common Bustard-Quail
Noted: Various localities

20. *Amaurornis phoenicurus* (Pennant) Whitebreasted Waterhen
Noted: Canacona

21. *Fulica atra* Linnaeus Coot
Noted: North Goa

22. *Vanellus indicus* (Boddaert) Redwattled Lapwing
Noted: Molem, Canacona

23. *Tringa ochropus* Linnaeus
Green Sandpiper
Noted: Maem Lake

24. *Gelochelidon nilotica* (Gmelin) Gullbilled Tern
Noted: North Goa

25. *Treron pompadora affinis* (Jerdon) Grey-fronted Green Pigeon
Collected: Valpoi

♂ 146 g	142	20	23	moult
♀ 153 g	144	20	22	82

Elsewhere noted: Molem, Canacona

26. *Ducula badia* (Raffles) Imperial Pigeon
Noted: Canacona

27. *Columba livia* Gmelin Blue Rock Pigeon
Noted: Canacona

28. *Columba elphinstonii* (Sykes) Nilgiri Wood Pigeon
Collected: Molem

o ? 340 g	203	28	26	157

Elsewhere noted: Canacona

29. *Streptopelia orientalis erythrocephala* Bonaparte Rufous Turtle Dove
Noted: Maem Lake environs, Molem

30. *Streptopelia chinensis* (Scopoli) Rufous Turtle Dove
Noted: Maem Lake environs, Molem

31. *Streptopelia senegalensis* (Linnaeus)

Little Brown Dove
Noted: Canacona

32. *Chalcophaps indica* (Linnaeus) Emerald Dove
Noted: Molem

33. *Psittacula cyanocephala cyanocephala* (Linnaeus) Blossomheaded Parakeet
Collected: Molem
♂ 69 g 140 18 (from cere) *c.* 11 219
♀ 63 g 130 17 (from cere) *c.* 11 150
Elsewhere noted: Canacona

34. *Psittacula columboides* (Vigors) Blue-winged Parakeet
Noted: Canacona, Molem. Generally common.

35. *Loriculus vernalis* (Sparrman) Lorikeet
Noted: Valpoi

36. *Cuculus micropterus* Gould Indian Cuckoo
Noted: Canacona

37. *Eudynamys scolopacea scolopacea* (Linnaeus) Koel
Collected: Canacona
♂ 162 g 193 31 34 198
Elsewhere noted: Molem

38. *Centropus sinensis parroti* Stresemann Crow-pheasant
Collected: Molem
♀ 312 g 195 43 57 255
Elsewhere noted: Canacona

39. *Glaucidium radiatum* (Tickell) Barred Owlet
Noted: Maem Lake environs, Molem, Canacona, Valpoi

40. *Eurostopodus macrotis* (Vigors) Great Eared Nightjar
Noted: Valpoi. The characteristic whistling *whi-wheeew* calls were regularly heard in the evening at dusk.

41. *Caprimulgus indicus indicus* Latham Jungle Nightjar
Collected: Valpoi
♂ 60 g 189 24 14 125
By plumage and measurements it is difficult to differentiate *indicus* from the closely resembling neighbouring race *hazarae* without a series.

42. *Caprimulgus macrurus atripennis* Jerdon Longtailed Nightjar
Collected: Canacona
♂ 74 g 186 24 19 131

43. *Chaetura sylvatica* (Tickell) Whiterumped Spinetail Swift
Collected: Molem
o? 13 g 113 9 10 35

44. *Cypsiurus parvus* (Lichtenstein) Palm Swift
Noted: Molem

45. *Hemiprocne longipennis* (Rafinesque) Crested Tree Swift
Noted: Molem, Canacona, feeding parties over forest with characteristic *whit-tuck* calls.

46. *Harpactes fasciatus malabaricus* (Gould) Malabar Trogon
Collected: Molem, Canacona
♂ 64 g 125 20 15 158
2 ♀♀ 60 g, 64 g, 123,125 20,21 16,16 158, 166
Call, a deliberate unhurried *cue-cue-cue,* three or four times repeated.

47. *Alcedo atthis taprobana* Kleinschmidt Small Blue Kingfisher
Collected: Molem
♀ 23 g 69 42 10 30

48. *Alcedo meninting* ssp? Blue-eared Kingfisher
Collected: Canacona, Molem
♂ 25 g 71 44 11 31
♀ 28 g 71 43 9 31
By distribution and characters this specimen falls in ssp. *coltarti* Baker, but there is no way of distinguishing it from *rufigaster*. Humayun Abdulali (*JBNHS 64*:174) has already

indicated that it is difficult to separate *rufigaster* from *coltarti*.

49. *Halcyon smyrnensis* (Linnaeus) White-breasted Kingfisher
Noted: Maem Lake, Molem, Canacona

50. *Merops leschenaulti leschenaulti* Vieillot Chestnutheaded Bee-eater
Collected: Molem
♀ 24 g 108 39 12 81
Elsewhere noted: Maem environs

51. *Merops philippinus* Linnaeus Bluetailed Bee-eater
Noted: Maem Lake, near Bicholim, small numbers.

52. *Merops orientalis* Latham Little Green Bee-eater
Noted: Molem, Canacona

53. *Nyctyornis athertoni* (Jardine & Selby) Bluebearded Bee-eater
Noted: Molem (JDP)

54. *Coracias garrulus semenowi* Loudon & Tschudi Kashmir Roller
Collected: Canacona 7 Dec. 1972
♀ (imm) 120 g 190 40 24 124

An immature solo, apparently a straggler. Remiges and primary coverts freshly moulted. Rectrices and body plumage very worn. One of the two southernmost records from peninsular India, the earlier being from Karwar immediately south of Goa.

55. *Coracias benghalensis* ssp? Roller or Blue Jay
Collected: Molem
♀ 115 g 175 38 26 122
Elsewhere noted: Canacona

Nuchal collar is entirely absent, and it is lighter green on the upperparts than the subspecies *indica*. This specimen is not distinguishable from the northern race *bengalensis*. However, according to the range arbitrarily fixed, the specimen should be considered as *indica*. Commonly seen singly on telegraph wires.

56. *Upupa epops* ssp? Hoopoe
Collected: Molem
o? 59 g Wing — Bill 56 Ts 25 Tl—

In plumage and measurements the specimen agrees with the subspecies *epops* Linnaeus as well as with *saturata* Lönnberg. There is no character distinct enough to separate *epops* from *saturata*. Ali & Ripley (HANDBOOK *4*: 127) consider *saturata* as of questionable validity.

Elsewhere noted: Canacona

57. *Tockus griseus griseus* (Latham) Malabar Grey Hornbill
Collected: Molem
♂ 336 g 210 102 42 229
Elsewhere noted: Canacona

Dipping flight in silhouette very like *Nyctyornis* or *Megalaima virens*.

58. *Anthracoceros coronatus coronatus* (Boddaert) Malabar Pied Hornbill
Collected: Molem
♀ 1000 g 310 204 (from forehead) 160 (from gape) 51 310
Elsewhere noted: Canacona.

Orbital skin, cheek pads and gular skin pinkish creamy white. Bill creamy white. 2/3 of casque (terminal) and patch at base of lower mandible black.

59. *Buceros bicornis* Linnaeus Great Pied Hornbill
Noted: Molem
Party of 3 (RJP) Canacona

60. *Megalaima zeylanica inornata* Walden Large Green Barbet
Collected: Molem
♂ 123 g 123 36 30 71

61. *Megalaima viridis* (Boddaert) Small Green Barbet
Collected: Molem
♀ 84 g 100 26 27 59

62. *Megalaima rubricapilla malabarica* (Blyth) Crimsonthroated Barbet

Collected: Molem
♀ 38 g 82 18 21 38
In evergreen forest. Call like *haemacephala,* but faster in tempo.

63. *Micropternus brachyurus jerdonii* (Malherbe) Rufous Woodpecker
Collected: Molem
♂ 108 g 130 30 23 69
Elsewhere noted: Canacona

64. *Dinopium benghalense puncticolle* (Malherbe) Goldenbacked Woodpecker
Collected: Canacona
♂ 132 g 149 44 26 tail moult
The southern birds have been separated into two races; *puncticolle* having orange-yellow back and *tehminae* having golden olive-yellow back. However, it is hard to place this specimen or many others in the BNHS collection, obtained from various regions, under either of the races with certainty as the extent of gold and orange on the back is highly variable and not restricted to birds from any one area.

65. *Dryocopus javensis* (Horsfield)
Great Black Woodpecker
Noted: Molem (JDP), Canacona

66. *Picoides nanus hardwickii* (Jerdon)
Browncrowned Pigmy Woodpecker
Collected: Molem
♀ 15 g 75 16 15 35
Elsewhere noted: Valpoi

67. *Hemicircus canente* (Lesson)
Heartspotted Woodpecker
Collected: Molem and Canacona
2♂♂ 35, 38 g 93, 96 23, 24 19, 19 33, 34
♀ 30 g 92 19 17 34
Elsewhere noted: Molem: Pairs, Canacona: Common

68. *Chrysocolaptes lucidus chersonesus* Kloss
Larger Goldenbacked Woodpecker
Collected: Valpoi
2♀♀ 163, 164 g 152, 157 46, 49 31, 32 80, 82
This race has been separated from *sultaneus* and *guttacristatus* by the intensity of yellow and olive on the back. However, these specimens and others in the BNHS collection vary considerably in the extent of coloration inconsistent with the locality.

69. *Calandrella cinerea* (Gmelin)
Short-toed Lark
Noted: Canacona, in flocks

70. *Galerida malabarica* (Scopoli)
Malabar Crested Lark
Collected: Canacona
♂ 31 g 98 16 23 54

71. *Hirundo rupestris* Scopoli
Crag Martin
Noted: Valpoi
Distinguished from Dusky Crag Martin in overhead flight by pale underparts contrasting with blackish under tail-coverts.

72. *Hirundo rustica* Linnaeus Swallow
Noted: Panaji

73. *Hirundo daurica* Linnaeus Striated Swallow
Noted: Molem. Abundant on telegraph wires. Rump whitish. Subspecies *rufula* or *nipalensis*

74. *Lanius schach caniceps* Blyth
Rufousbacked Shrike
Collected: Molem
♂ 28 g 89 21 28 —
Elsewhere noted: Maem environs, Canacona.

75. *Lanius cristatus cristatus* Linnaeus
Brown Shrike
Collected: Molem
♂ 32 g 89 19 26 85

76. *Oriolus oriolus kundoo* Sykes
Golden Oriole
Collected: Molem
♂ 60 g 142 31 24 —

Elsewhere noted: Canacona

77. *Oriolus xanthornus* (Linnaeus)
Blackheaded Oriole
Noted: Molem, Canacona

78. *Dicrurus adsimilis* (Bechstein)
Black Drongo
Collected: Molem
♂ 49 g 151 23 22
Tail central 153 outer 103

Two subspecies are recognized from India: *Dicrurus adsimilis albirictus* and *Dicrurus adsimilis macrocercus*, separated only on size. The former (northern) has wing 145-165 and the latter (peninsular) 130-145. Perhaps if more specimens with such long wings can be obtained from the south we might be able to group all the Indian populations in a single cline. Alternatively there may be a certain amount of migration from the north into peninsular India in winter, and the above specimen may be one of such migrants.

79. *Dicrurus leucophaeus longicaudatus* Hay
Grey Drongo
Collected: Molem
♀ 37 g 128 27 19 88/143
Elsewhere noted: Canacona, in a mixed foraging party in forest.

Measurements of the races overlap and hence in the absence of a series only the area of collection, which is within the known wintering range, has been taken as the criterion for identification.

80. *Dicrurus caerulescens caerulescens* (Linnaeus) Whitebellied Drongo
Collected: Molem
3 ♂♂ 36-40 g 123-131 25-26 19-21 110-122
Elsewhere noted: Canacona

81. *Dicrurus aeneus aeneus* Vieillot
Bronzed Drongo
Collected: Canacona
o? 23 g 113 23 17 90/105
Elsewhere noted: Molem

82. *Dicrurus hottentottus hottentottus* (Linnaeus) Haircrested Drongo
Collected: Canacona, Valpoi
2 ♂♂ 81,82 g 165(2) 39,41 26,27 119,124 134,138

The bill measurements quoted from Vaurie in INDIAN HANDBOOK (5:133) as 26-30 mm for males are wrongly stated to be 'from skull'; actually they are 'from feathers'. SA. measures bill 'from skull' of his own specimens as
6 ♂♂ 39-43, 8 ♀♀ 36-42

83. *Dicrurus paradiseus paradiseus* Linnaeus
Large Racket-tailed Drongo
Collected: Molem
♂ 80 g 154 32 28 racket feathers missing (moult?)
o? 84 g 163 36 28 420
Elsewhere noted: Canacona

84. *Sturnus malabaricus* (Gmelin)
Greyheaded Myna

Noted: Maem environs, flock *c.* 30. The flock contained some unmistakable examples of the white-headed form *blythii*. Panaji.

85. *Acridotheres tristis* (Linnaeus)
Indian Myna
Noted: Canacona and elsewhere—particularly around habitations.

86. *Acridotheres fuscus* (Wagler)
Jungle Myna
Noted: Canacona

87. *Dendrocitta vagabunda* (Latham)
Tree Pie
Noted: Maem Lake environs; Molem, Canacona.

88. *Corvus splendens* Vieillot House Crow
Noted: Molem, Canacona, Panaji. Abundant. Vast roosting congregations in trees around the Circuit House and in Panaji city, whitening the ground below.

89. *Corvus macrorhynchos* Wagler
Jungle Crow

Noted: Molem, Canacona, Maem and Bicholim environs. Commoner than *splendens* around outlying hamlets.

90. *Hemipus picatus picatus* (Sykes)
Pied Flycatcher-Shrike
Collected: Canacona
♂ 9 g 60 15 12 56

91. *Tephrodornis gularis sylvicola* Jerdon
Large Wood Shrike
Collected: Canacona
♀ 41 g 114 28 20 83
o? 41 g 114 28 20 80

92. *Tephrodornis pondicerianus* (Gmelin)
Common or Lesser Wood Shrike
Noted: Maem Lake environs. Molem, Canacona

93. *Coracina novaehollandiae* (Gmelin)
Large Cuckoo-Shrike
Noted: Canacona

94. *Coracina melanoptera sykesi* (Strickland)
Blackheaded Cuckoo-Shrike
Collected: Molem
o? 30 g 108 20 — —
Elsewhere noted: Canacona

95. *Pericrocotus flammeus flammeus* (Forster) Orange Minivet
Collected: Molem
♂ 26 g 92 19 17 80
Elsewhere noted: Canacona, in mixed foraging parties in forest.

96. *Pericrocotus roseus roseus* (Vieillot)
Rosy Minivet
Collected: Canacona
♀ 18 g 81 17 15 82
No yellow except on the speculum, tail, and under wing-coverts. Probably an immature bird. There is no record from or around Goa. Recorded as occasional winter visitor in Maharashtra, Kerala and Madhya Pradesh.

97. *Pericrocotus cinnamomeus malabaricus* (Gmelin) Small Minivet
Collected: Valpoi
♂ 10 g 67 13 16 68
An immature bird whose racial status has been decided only by range.
Elsewhere noted: Molem, Canacona

98. *Aegithina tiphia deignani* Hall Iora
Collected: Canacona
♂ 15 g 65 19 19 47
Subspecific status decided by range. Plumage and measurements are not markedly different from other subcontinental races.
Elsewhere noted: Molem

99. *Chloropsis aurifrons frontalis* (Pelzeln)
Goldfronted Chloropsis
Collected: Molem
♀ 30 g 88 20 16 60
Elsewhere: Canacona. In mixed foraging parties in forest. Subspecies based on known and arbitrarily fixed range of distribution, though the specimen is somewhat smaller.

100. *Chloropsis cochinchinensis jerdoni* (Blyth) Jerdon's Chloropsis
Collected: Canacona
♂ 30 g 92 24 19 71
♀ 26 g 84 24 19 65
The male appears immature as the throat is only patchily black and without the yellowish penumbra.

101. *Irena puella puella* (Latham)
Fairy Bluebird
Collected: Molem
♂ 66 g 123 29 19 97
♀ 57 g 121 26 20 96
Elsewhere noted: Canacona, in mixed foraging parties in forest.

102. *Pycnonotus priocephalus* (Jerdon)
Greyheaded Bulbul
Collected: Molem, Canacona
4 ♂♂ 21-28 76-77 15-17 16(4) 72-80
The chin colour (black) is restricted in all the four specimens and does not extend to the throat as in some examples in the BNHS collection. But this character is not consistent,

and both types are found within more or less the same geographical range.

103. *Pycnonotus melanicterus gularis* (Gould) Rubythroated Yellow Bulbul
Collected: Molem
2♂♂ 18,22 g 75,80 15(2) 15,17 70,76
2♀♀ 15,19 72,73 15(2) 16,17 69(1)
Elsewhere noted: Canacona
The occurrence of this bulbul in Goa, questioned in the INDIAN HANDBOOK (6:73), is now confirmed.

104. *Pycnonotus jocosus fuscicaudatus* (Gould) Redwhiskered Bulbul
Collected: Molem
♂28 g 85 20 22 80
Elsewhere noted: Canacona, Maem

105. *Pycnonotus cafer* (Linnaeus) Redvented Bulbul
Noted: Molem, Canacona

106. *Pycnonotus luteolus luteolus* (Lesson) Whitebrowed Bulbul
Collected: Canacona
♀31 g 87 20 22 81
Common in bush country.

107. *Hypsipetes indicus indicus* (Jerdon) Yellowbrowed Bulbul
Collected: Valpoi
3♂♂31-35 g 89-95 20-22 18-20 80-81
2♀♀ 28,31 g 89,93 20,21 19,20 76,81
Elsewhere noted: Canacona. In mixed foraging parties in forest.

108. *Hypsipetes madagascariensis* (P.L.S. Müller) Black Bulbul
Noted: Molem, Canacona

109. *Pellorneum ruficeps ruficeps* Swainson Spotted Babbler
Collected: Molem
♂31 g 77 20 28 72
2♀♀ 26,27 g 69(2) 20(1) 27(2) 60(1)
Elsewhere noted: Canacona

110. *Pomatorhinus schisticeps* Hodgson Scimitar Babbler
Noted: Molem

111. *Rhopocichla atriceps atriceps* (Jerdon) Blackheaded Babbler
Collected: Molem, Canacona
3♂♂ 15-16 g 56-60 14-16 22-24 49-50

112. *Turdoides subrufus subrufus* (Jerdon) Rufous Babbler
Collected: Molem
♂57 g 92 23 35 114
♀58 g 90 22 35 107

113. *Turdoides striatus somervilleii* (Sykes) Jungle Babbler
Collected: Molem
2♂♂ 66,69g 98,101 23(2) 36,37 94,100
Elsewhere noted: Canacona

114. *Alcippe poioicephala poioicephala* (Jerdon) Quaker Babbler
Collected: Molem, Canacona, Valpoi
2♂♂ 17,20g 72,73 16,17 22,23 64,66
2♀♀ 20,21 g 70,74 16,18 22(2) 65(2)
1♂juv.
Foraging parties, often high up in trees.

115. *Muscicapa muttui muttui* (Layard) Brownbreasted Flycatcher
Collected: Molem
♂12 g 70 16 15 52
2♀♀ 10,10 g 69,72 16,16 14,15 48,49
o? 10 g 71 17 15 51
Elsewhere noted: Canacona

116. *Muscicapa parva parva* Bechstein Redbreasted Flycatcher
Collected: Molem
o? 8 g 66 11 14 46
Elsewhere noted: Canacona

117. *Muscicapa superciliaris superciliaris* Jerdon Whitebrowed Blue Flycatcher
Collected: Molem
♂8 g 62 15 15 46

118. *Muscicapa pallipes* Jerdon Whitebellied Blue Flycatcher
Collected: Molem
♂20 g 78 17 19 63

3 ♀ ♀ 18-20 g 70-73 17-18 19(3) 55-56
Elsewhere noted: Canacona

119. *Muscicapa rubeculoides rubeculoides* (Vigors) Bluethroated Flycatcher
Collected: Valpoi
♂ 13 g 74 14 18 53
o? 12 g 70 14 17 51

120. *Muscicapa tickelliae* (Blyth)
Tickell's Redbreasted Blue Flycatcher
Collected: Molem, Valpoi
2 ♂ ♂ 14(2) g 72,73 15,17 18(2) 55(2)
2 ♀ ♀ 13,17 g 69,71 15,17 17,19 55(2)
Elsewhere noted: Canacona

121. *Muscicapa thalassina thalassina* Swainson Verditer Flycatcher
Collected: Molem, Valpoi
♂ 17 g 84 13 15 —
♀ 17 g 80 13 16 64
Elsewhere noted: Canacona

122. *Terpsiphone paradisi leucogaster* (Swainson) Paradise Flycatcher
Collected: Molem
♂ 17 g 92 24 17 242
Male in chestnut plumage with white underparts, presumably on migration.
Noted: Molem, Canacona; in mixed foraging parties in forest, possibly with other subspecies.

123. *Monarcha azurea styani* (Hartlaub)
Blacknaped Monarch Flycatcher
Collected: Valpoi, Molem
♂ 9 g 69 — 17 69
2 ♀ ♀ 9,11 g 68,69 15(2) 16,17 65,67
Elsewhere noted: Maem environs, Canacona
In mixed foraging parties in forest.

124. *Orthotomus sutorius* (Pennant)
Tailor Bird
Noted: Molem, Canacona and elsewhere

125. *Acrocephalus dumetorum* Blyth
Blyth's Reed Warbler
Collected: Molem
♂ 10 g 62 18 23 50
♀ 11 g 62 18 23 53
Elsewhere noted: Canacona

126. *Phylloscopus tytleri* Brooks
Tytler's Leaf Warbler
Collected: Canacona
♂ 7 g 58 13 18 42

Very little is known of its wintering habits. So far only three specimens have been recorded, south of its breeding area. The records are from Khandala, Londa and Nilgiris. This specimen from Goa is thus the fourth record from the western ghats and it may be assumed that *Phylloscopus tytleri* is a regular winter visitor to the western ghats. The specimen has worn wing and tail feathers.

127. *Phylloscopus griseolus* Blyth
Olivaceous Leaf Warbler
Collected: Molem
♂ 8 g 64 14 18 48
This species is known to winter down to North Kanara.

128. *Phylloscopus occipitalis occipitalis* (Blyth) Large Crowned Leaf Warbler
Collected: Molem, Canacona
3 ♂ ♂ 8(3) g 65-67 13-15 18-19 49-51
o? 8 g 62 15 17 47

129. *Copsychus saularis* (Linnaeus)
Magpie Robin
Noted: Bicholim; Canacona; Molem

130. *Copsychus malabaricus malabaricus* (Scopoli) Shama
Collected: Canacona; in mixed foraging parties in forest.
♀ 28 g 88 19 26 122

Placed in the nominate race by locality. This and the neighbouring race *indicus* are separated only by the length of the tail which averages shorter in the latter. The tail of this specimen is within the overlapping limits of both the races.

131. *Phoenicurus ochruros* (S. G. Gmelin)

Redstart
Noted: Molem

132. *Saxicoloides fulicata* (Linnaeus)
Indian Robin
Noted: Canacona. Common generally.

133. *Monticola cinclorhynchus* (Vigors)
Blueheaded Rock Thrush
Collected: Molem, Canacona.
3♂♂ 32-33g 99-103 22-24 24-26 65-69
o? 31 g 98 22 24 64
Elsewhere noted: Canacona. In mixed foraging parties in forest.

143. *Monticola solitarius* (Linnaeus)
Blue Rock Thrush
Noted: Molem, Canacona.

135. *Myiophoneus horsfieldii* (Vigors)
Malabar Whistling Thrush
Noted: Molem

136. *Zoothera citrina cyanotus* (Jardine & Selby) Whitethroated Ground Thrush
Collected: Molem, Valpoi
2♂♂ 48,52g 105,109 23,24 30,32 70,72
Elsewhere noted: Canacona

137. *Turdus merula nigropileus* (Lafresnaye)
Blackcapped Blackbird
Collected: Molem, Valpoi
2♂♂ 69,73g 121,129 25,26 32(2) 91,93

One of the specimens (No. 50) comes under *nigropileus* by plumage, measurements and range of distribution.

The other specimen (No. 135) differs as follows: It does not have a distinct collar behind nape. It is possibly not fully adult as seen from pale brownish edges to the upper wing-coverts. But as immature it should also have streaks on the throat and other places which are totally lacking in this specimen, and, but for the upper wing-coverts it is adult plumage. By plumage the bird belongs to the subspecies *simillimus*. Measurements are within the known limits. The only difference then would be the bill which was dark with orange gape which is known to be a colour variation in *nigropileus* HANDBOOK 9:119 (1973). In *T. merula simillimus* the bill colour is recorded as only orange yellow.

The implication here is: 1. The specimen is of the subspecies *T. merula simillimus* and its bill colour, possibly an unrecorded variation.

or 2. A hybrid between the subspecies *nigropileus* and *simillimus.*

The latter (2) is more acceptable as the place of collection is the transitional area of the two subspecies.

Elsewhere noted: Canacona, in mixed foraging party in forest.

138. *Sitta frontalis frontalis* Swainson
Velvetfronted Nuthatch
Collected: Molem
♂12 g 72 14 18 38

139. *Anthus hodgsoni* ssp?
Tree Pipit
Collected: Molem
♂22 g 85 14 21 60

Two subspecies namely *hodgsoni* and *yunnanensis* are known to winter in India. It is difficult to place this single specimen under either.

140. *Anthus trivialis* (Linnaeus) Tree Pipit
Collected: Molem
♂21 g *c.* 84 15 22 *c.* 60

The specimen cannot be placed with certainty with either *trivialis* or *haringtoni* the two subspecies that winter in the Peninsula. *Haringtoni* is more earth brown, less olive above, and its bill is slightly broader at the base.

Elsewhere noted: Canacona

141. *Motacilla indica* Gmelin
Forest Wagtail
Collected: Molem
♂16 g 85 16 22 72

142. *Motacilla caspica* (Gmelin)

Grey Wagtail
Noted: Molem

143. *Motacilla maderaspatensis* Gmelin
Large Pied Wagtail
Noted: Near Mapsa

144. *Dicaeum agile* (Tickell)
Thickbilled Flowerpecker
Noted: Valpoi

145. *Dicaeum concolor* Jerdon
Plaincoloured Flowerpecker
Collected: Molem, Canacona.
3 ♀ ♀ 5-6.5 g 45-45.5 11-13 12.5(2) 21-23

146. *Nectarinia zeylonica sola* (Vieillot)
Purplerumped Sunbird
Collected: Canacona
♂ 8 g 56 19 17 35
Elsewhere noted: Molem: commonly on flowering *Loranthus* clumps.

147. *Nectarinia minima* (Sykes)
Small Sunbird
Collected: Molem, Valpoi
2 ♀ ♀ 5(2)g 41,44 14(2) 13,14 24,25
Elsewhere noted: Canacona

148. *Nectarinia lotenia hindustanica* (Whistler) Maroonbreasted Sunbird
Collected: Molem
♂ 8 g 57 28 15 38
Subspecies identified by locality.
Elsewhere noted: Canacona

149. *Nectarinia asiatica asiatica* (Latham)
Purple Sunbird
Collected: Molem
♂ 8g 57 22 15 34
Elsewhere noted: Canacona
In regular attendance on flowering *Loranthus* abundantly parasiting 3 species of *Terminalia* in Molem forest.

150. *Passer domesticus* (Linnaeus)
House Sparrow
Noted: Common and abundant at Panaji.

151. *Petronia xanthocollis* (Burton)
Yellowthroated Sparrow
Noted: Molem, Canacona

152. *Ploceus philippinus philippinus* (Linnaeus) Baya Weaver Bird
Collected: Molem
♂? 25g 65 18 22 42

153. *Lonchura striata striata* (Linnaeus)
Whitebacked Munia
Collected: Valpoi
o? 11 g 52 12 14 40

154. *Emberiza melanocephala* Scopoli
Blackheaded Bunting
Collected: Molem
♀ 25 g 89 17 23 67

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New mammal records from Nepal[1& 2]

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(*With a text-figure*)

In this paper, five new records of mammals collected from Nepal are discussed. Two ungulates (*Ovis ammon* and *Tragulus meminna*) and three insectivores (*Crocidura attenuata, Suncus stoliczkanus* and *S. etruscus pygmaeoides*) are reported from Nepal for the first time. The new locality records are provided and the general ecology of the areas from which the mammals were collected is discussed.

INTRODUCTION

Relatively few mammal surveys have been conducted in Nepal due to its inaccessibility to foreigners until 1952. With the signing of the Treaty of Saguli (Karan 1960) the British sent an envoy to the Kathmandu Valley in 1815. Under the direction of Hodgson, 70 genera and 114 species of mammals were collected of which 40 species were described as new (Gray 1846, 1863). During the 1920's several expeditions entered Nepal from the northern approach to Mount Everest resulting in the collection of 52 mammal specimens belonging to 10 species. Two species and one subspecies were described as new (Thomas & Hinton 1922). Hinton (1922) provided a detailed report on the house rats of Nepal based on earlier collections. Hinton & Fry (1923) reported on the mammal survey conducted by the Bombay Natural History Society from 1922 to 1923. They listed a collection of 304 specimens consisting of 34 genera and 44 species. Biswas & Khajuria (1955) collected a small series of mammals from east Nepal of which two species and two subspecies were described for the first time. A later list of the mammals of eastern Nepal was provided by Biswas & Khajuria (1957). The Nepal Health Survey 1965-1966 collected 460 mammals consisting of 18 genera and 28 species (Worth & Shah 1969). In 1968, the German Nepal Himalaya Expedition investigated the Insectivora and Rodentia of eastern Nepal and listed 10 genera and 14 species (Weigel 1969).

Since there was very little information avail-

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able with respect to the mammal and ectoparasite fauna of Nepal, an extensive host-parasite programme was undertaken from July 1966 to August 1970. Over 4000 mammal specimens were collected during this period. From this material, two ungulates (*Ovis ammon* and *Tragulus meminna*) and three insectivores (*Crocidura attenuata, Suncus stoliczkanus* and *S. etruscus pygmaeoides*) are reported from Nepal for the first time in this study. Nepal is divided into seven geographical life zones (Chesemore 1970, Hagen 1961; Karan 1960). These life zones are described in detail by Hagen (1961). The present paper provides a listing of the new locality records with a description of the general ecology of the areas from which the mammals were collected or sighted. A distribution map of the new locality records is provided (Fig. 1).

Distribution records

1. *Ovis ammon hodgsoni* Blyth, 1841 (The Nayan or Great Tibetan Sheep)

1 specimen: Mugu, Mugu District—29°48′N, 82°33′E.

1 sighting: Chum Gompa, Gorka District—28°35′N, 85°07′E.

The previously recorded distribution of this species encompasses Tibet (Ellerman & Morrison-Scott 1966). *O. a. hodgsoni* is a race of the Argali *Ovis ammon* (Linnaeus). Unsubstantiated reports of this species exist for the northern border areas of Nepal (Ellerman & Morrison-Scott 1966; Prater 1965). Earlier reports by Hodgson (in Gray 1846) listed four *O. ammon* skulls as being collected from the northern hilly regions of Nepal. It is difficult to discern the validity of these records since

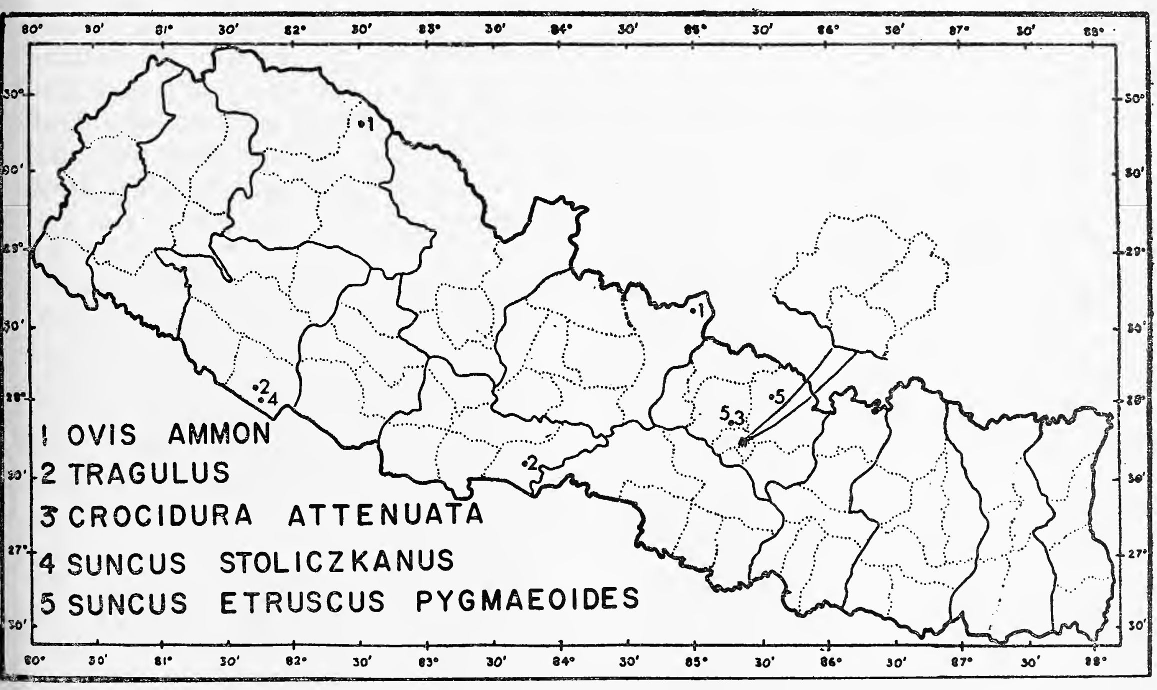

Fig. 1. New locality records for five species of mammals from Nepal.

Hodgson was confined to the capital city of Kathmandu and had to depend on traders and local hunters for his specimens.

New locality records for *Ovis ammon hodgsoni* were obtained from two different sites in Nepal (Fig. 1, 1). In March, 1968, the skull of a five-year old ram was found near Mugu in the high Himalayas of western Nepal at an elevation of 4700 m. Mugu is a small village located in far western Nepal situated near the northern border adjacent to Tibet. It is surrounded by the Ladakh Himal and Great Himalayan Range on the north with the Kanjeroba Himal massif enclosing it from the east (Hagen 1961). In addition, local people reported sighting an occasional band of these wild sheep between the months of February and April. The sheep seem to stray across the Tibetan border during this season. Additional ungulates that occur in this region are the bharal (*Pseudois nayaur*) and the Himalayan tahr (*Hemitragus jemlahicus*).

A new sighting record of *O. a. hodgsoni* at a second locality in Nepal was reported to the authors by an Austrian engineer, Mr. Peter Aufschneider, who photographed a band of 15 nayan above Chum Gompa (28°35′N, 85°07′ E). Chum Gompa, located in north central Nepal (Fig. 1), is an isolated village inhabited by migratory herdsmen during the summer months. Broad alpine meadows project from the steep face of the Greater Himalayas. The sheep graze on the southern slopes which are close to rocky outcroppings.

2. *Tragulus meminna* Erxleben, 1777 (Indian Spotted Chevrotain or Mouse Deer)

1 specimen: Mahadeva, Banke District—28°13′N, 81°56′E, at an elevation of 227 m.

3 sightings: 2 Mahadeva, 1 Tamispur, Nawal Parsi District—27°34′N, 83°57′E, at an elevation of 97 m.

The approximate distribution of this species encompasses Ceylon and peninsular India; in India north to the central provinces (Ellerman & Morrison-Scott 1966). Prater (1965) lists the distribution of the chevrotain as the forested areas of Ceylon and southern India at elevations up to 1850 m, with 24°N latitude being the approximate limit of its northerly range. Three Indian chevrotain were sighted and one partial skeleton collected in the Nepal terai (28°N) by the senior author.

The first sighting of the chevrotain in Nepal was on 15 February 1968, at Tamispur (Fig. 1—27°34′N, 83°57′E). It was seen in tall elephant grass (*Cymbopogon* sp.) at a distance of 3 m. Tamispur is situated at the far western end of the Rapti Valley which is surrounded by the Mahabharat Range to the north and the Churia Hills to the south. This area lies near the juncture of the Binai Nadi and Narayani rivers. Homogenous stands of sal (*Shorea robusta*) grow on the slopes of the Mahabharat and Churia hills up to 1250 m. These forests extend to the edge of the alluvial flood plain. *Acacia* and *Dalbergia* grow along the rivers and cover the flood plain. Elephants grass (*Cymbopogon* sp. and *Bothriochloa* sp.) occurs commonly in the disturbed areas around human habitations and the marshy lowlands.

Additional ungulates found in the Tamispur area are: gaur (*Bos gaurus*), nilgai (*Boselaphus tragocamelus*), four horned antelope (*Tetracerus quadricornis*), sambar (*Cervus unicolor*), chital (*Axis axis*), hog deer (*Axis porcinus*), barking deer (*Muntiacus muntjak*), wild boar (*Sus scrofa*) and rhinoceros (*Rhinoceros unicornis*).

In March, 1969, a partial skeleton was obtained and two live chevrotain sighted in the western terai of Nepal at Mahadeva (28°13′N, 81°46′E). Local hunters brought in a decomposed carcass for the senior author to examine.

In addition, two chevrotain were sighted in a dense stand of sal (*Shorea robusta*). Mahadeva is located in western Nepal at the base of the Siwalik foothills. Dense stands of sal cover the southern slopes of the Siwallks up to an elevation of 1300 m. Cultivation is prominent with rice and mustard the principal crops raised. The sal forests are interspersed with lianas (*Terminalia* sp. and *Anogeissus* sp.). *Acacia* sp. and *Ribes* sp. predominate in disturbed areas. Tamarix thickets line the rivers and flood plains.

Many of the ungulates found at Tamispur occur at Mahadeva with the exception of gaur and rhinoceros. Both of these species have been eliminated from the area by extensive hunting. Small herds of swamp deer (*Cervus duvauceli*) occur among Tamarix thickets that grow along the streams of the area.

3. *Crocidura attenuata* Milne-Edwards, 1872, (Gray Shrew)

1 specimen: Kakani, Nuwakot District—27°49′N, 85°16′E, at an elevation of 2440 m.

The approximate distribution of this species is Assam, Bhutan, Sikkim, and Darjeeling (Ellerman & Morrison-Scott 1966). A single specimen of *Crocidura attenuata* was trapped at Kakani in the central midlands of Nepal (Fig. 1, 3). Two additional specimens were collected in Darjeeling, West Bengal, India, 20 km east of Nepal. Kakani is located on the southern flank of the Sheopuri Mountain Range. The north and east slopes are covered with natural stands of vegetation and the south and west slopes are heavily farmed. The area is characterized as a warm-temperate zone with three distinct broad-leaf forest types: mixed forests of *Schima-Castanopis* at the base of the mountains; oak-laurel at middle elevations; and oak-rhododendron at the mountain tops.

Many small mammals were trapped along the forest edge bordering cultivated fields. These included *Mus musculus urbanus, Rattus nitidus, R. niviventer, R. turkestanicus, Soriculus caudatus, S. nigrescens, Suncus murinus, S. etruscus,* and *Golunda ellioti.*

4. *Suncus stoliczkanus* Anderson, 1877 (Anderson's Shrew)

2 specimens: Bahwanipur, Banke District—27°57′N, 81°47′E, at an elevation of 158 m.

The approximate distribution of this species is Madras, Bombay, Rajputana, and Central India Provinces (Ellerman & Morrison-Scott 1966). Two specimens were taken in the village of Bahwanipur, thus extending the range to the western terai of Nepal (Fig. 1, 4). The vegetation of the area is similar to that described for Mahadeva. Thorn brush (*Ribes* sp. and *Jasminum* sp.) has overgrown abandoned fields. The two specimens were trapped from a thorn brush fence row surrounding a mango grove.

Additional small mammals taken in the vicinity were *Mus booduga, M. platythrix, Vandeleuria oleracea, Golunda ellioti, Tatera indica, Millardia meltada, Lepus nigricollis,* and *Herpestes edwardsi.*

In Nepal, the genus *Suncus* is represented by a pygmy species, *etruscus,* a medium-sized species, *stoliczkanus,* and a giant species, *murinus.* *S. stoliczkanus* resembles an immature *S. murinus.* The head and body length of *S. stoliczkanus* usually averages 65-75 mm while in *S. murinus* the head and body length is well over 110 mm.

5. *Suncus etruscus pygmaeoides* Anderson, 1877 (Pygmy Shrew)

9 specimens: 1 Kakani

8 Melumchi, Sindu District—28°03′N, 85°33′E, at an elevation of 2455 m.

The approximate distribution of this species

is Darjeeling District, northeastern India (Ellerman & Morrison-Scott 1966). Nine pygmy shrews were collected at high altitudes (2440-2455 m) in the central midlands of Nepal. The previous distribution record of *S. etruscus pygmaeoides* extended to the eastern border of Nepal (88°15'E latitude). The present collections extend the distribution of pygmy shrews to 85°33'E, some 225 km west of the old records.

One pygmy shrew was collected at Kakani (27°49'N, 85°16'E) and the remaining eight were trapped at Melumchi (Fig. 1, 5). The collection site of Kakani has been previously described. Melumchi village is located in the central midlands of Nepal and lies on a southern exposure. The area is extensively farmed with wheat, millet and potatoes raised in small plots surrounded by stone fences. These stone fences are overgrown with ferns, willows (*Salix* sp.) and wild roses (*Rosa sericea*). All specimens of *S. e. pygmaeoides* were trapped from these stone fences during July and August, 1970.

Additional small mammals trapped at Melumchi included *Mus musculus homourus, Soriculus caudatus, S. leucops, S. nigrescens, Rattus fulvescens, R. turkestanicus, R. niviventer, R. nitidus, Vandeleuria oleracea, Suncus murinus* and *Dremomys lokriah.*

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Identity of *Amaranthus polygamus* of Hooker's flora of British India and related taxa[1]

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Amaranthus polygamus of Indian floras having flowers with three tepals and three stamens has been wrongly considered conspecific with penta-tepalous and pentandrous *A. polygonoides* Linn. of Jamaica by several authors. The cause for the confusion has been discussed. *A. polygamus* of Indian floras and *A. polygamus* Linn. are distinct taxa and the latter is conspecific with *A. tricolor* Linn. *A. polygamus* of Indian floras has been named *A. roxburghianus* by Nevski. The status of *A. aschersonianus* Thell. is discussed and it is considered as *A. roxburghianus* Nevski var. *aschersonianus* (Thell.) N. C. Nair. A new combination *A. roxburghianus* Nevski var. *angustifolius* (Moq.) N. C. Nair is made. The distinguishing characters of *A. lividus* Linn. subsp. *polygonoides* (Moq.) Probst. are given.

There has been much confusion with regard to the identity of the plant which goes by the name *Amaranthus polygamus* of Hooker's FLORA OF BRITISH INDIA 4:721, 1885. This is a small prostrate or ascending herb with small oblong-lanceolate, linear-obovate or linear-obovate-obtuse leaves, clusters of axilliary flowers having three acute and awned tepals (awns shorter than the leafy part of the tepal) which are longer than the bracteoles and shorter than the utricle, and three stamens. It has been referred to be *A. polygamus* Linn. Amoen. Acad. 4:294, 1759 by writers of Indian floras. Even the reference to Amoen. Acad. 4:294, 1759 is incorrect as Linnaeus published the name earlier in Centurea Plantarum 32, 1755. The descriptions given in these publications are exactly the same and based on the same type. *A. polygamus* of Indian floras is different from *A. polygamus* Linn. *A. polygamus* Linn. and *A. tricolor* Linn. Sp. Pl. 989, 1753 are conspecific and they are treated likewise in all current taxonomic literature. *A. polygamus* of Indian floras (non Linn.) can be distinguished from *A. tricolor* Linn. by several well-defined characters (*see* Nair, Bull. Bot. Surv. India 8(1):88, 1967). The question arises as to what is the correct name of *A. polygamus* of Indian floras. *A. polygamus* auct. non Linn. is often, wrongly, considered to be the same as *A. polygonoides* Linn. Fl. Jam. Pugill. 2:21, 1759; Amoen. Acad. 5:382, 1760. That *A. polygamus* of Indian floras and *A. polygonoides* Linn. are two distinct species having clear cut characters will be evident from the following discussion. Let us examine what are the characters of *A. polygonoides* Linn. and how this taxon is different from *A. polygamus* of Indian floras.

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Linnaeus' type description for *A. polygonoides* is "calycibus infundibuliformibus, obtusis, singularis." This description is very brief and does not speak about the number of the tepals and stamens. Linnaeus based the name *A. polygonoides* Linn. on *Blitum polygonoides* of Sloane (Voyage 1:144, 1707). Sloane also provides a figure (loc. cit. t. 92, f. 2, 1707). His description of the flower of *Blitum polygonoides* is as follows "…..without any foot-stalks. Each of them is small, pentapetalous, of a pale green colour, with a purple streak on each of the petala, and a green stamen within, after each of which follows a round compressed blackish brown shining seed." From this, it is clear that what Linnaeus named as *A. polygonoides* is a pentatepalous and pentandrous plant. Yet, several authors considered that *A. polygonoides* has tritepalous and triandrous flowers. It is surprising that Kniphofii (Herb. Viv. 1: t. 56, 1758) described the species as having "glomerulis triandris, axillaribus, foliis ovatis retusis." His figure is entirely different from that of Sloane's. Willdenov (Hist. Amar. 11, t. 61, f. 12 a & b, 1790) following Kniphofii's description (?) gave the diagnostic characters of *A. polygonoides* Linn. as "glomerulis triandris triphyllis." His figures like that of Kniphofii's do not have any similarity with Sloane's figure. It is obvious that Kniphofii and Willdenov did not refer to Sloanes' work. They assumed that *A. polygonoides* has three tepals and three stamens. These mistakes have been perpetuated all along. Roxburgh (Fl. Ind. 3: 602, 1832) considered the tritepalous triandrous Indian plant as *A. polygonoides* and cited the authority of Willdenov. Wight (Ic. 2: t. 719, 1843) also called it *A. polygonoides*. Ulini & Bray (Bot. Gaz. 19:267-272, 1894) treated *A. polygonoides* under plants having two or three stamens. Trimen (Handb. Fl. Ceyl. 3: 397-398, 1895) combined *A. polygamus* auct. (non Linn.) with *A. polygonoides* Linn. Aellen (in Fl. Eur. 1:110 & 432, 1964) united *A. lividus* Linn. and *A. blitum* Linn. with *A. polygonoides* Linn. I also wrongly inferred that the correct name of *A. polygamus* of Indian floras as *A. polygonoides* Linn. This is a very clear example which stresses the need for consulting original descriptions and figures in taxonomic researches.

A. polygonoides Linn. is a native of Jamaica and it has recently been reported from India by Naik [J. Bombay nat. Hist. Soc. 64(1):134, 1967; Indian Forest. 95(6); 416, 1969]. I have collected this plant from Kerala in May 1969 and it is very distinct from that of *A. polygamus* auct. (non Linn.).

A. polygamus of Indian floras has also been confused with another taxon by authors of European floras. Thellung [in Aschers. et Graeb. Syn. Mitteleur. Fl. 5(1):308, 1914] considered *A. polygamus* auct. (non Linn.) as a subspecies of *A. angustifolius* Lamk. Ency. 1:115, 1783. *A. angustifolius* Lamk. is an illegitimate name of *A. graecizans* Linn. Sp. Pl. 990, 1753 which is a native of Mediterranean region, West Asia and tropical Africa. This taxon is similar to *A. polygamus* of Indian floras but the latter has narrow lanceolate and acute tepals with drawn out apical point (apical point 0.26-0.76 mm) and bracteoles of similar form. Thus *A. graecizans* Linn. and *A. polygamus* of Indian floras can be regarded as two distinct species. As all the earlier names applied to this plant are illegitimate it has been named by Nevski as *A. roxburghianus*. The nomenclature of the Indian plant is as follows:

Amaranthus roxburghianus Nevski in Act. Inst. Bot. Acad. Sc. USSR, Ser. 1, Fasc. 4, 311, 1937 in Obs. (*roxburghiano*). *A. polygonoides* Roxb. Fl. Ind. 3:602, 1832 (non Linn.); Wight, Ic. Ind. Or. 2(4): t. 719, 1843 (non

t. 512); Trimen, Handb. Fl. Ceylon 3:397, 1895; Nair in Bull. Bot. Surv. India 8(1): 1967. *A. blitum B. polygonoides* Moq. in DC. Prodr. 13(2): 263, 1849. *Euxolus polygonoides* Miq. Fl. Ind. Batav. 1:1034, 1855; Thw. Enum. Pl. Zey. 218, 1864. *Amblogyna polygonoides* Dalz. et Gibs. Bomb. Fl. 218, 1861. *Albersia polygama* Boiss. Fl. Orient. 4:991, 1875. *Amaranthus polygamus* Hook. f. Fl. Brit. India 4:721, 1885 (non Linn.); Prain, Beng. Pl. 2:871; 1903; Cooke, Fl. Pres. Bomb. 2:491, 1906; Duthie, Fl. Upp. Gang. Pl. 3:14, 1915; Gamble, Fl. Pres. Madras 2:1171, 1925. *A. angustifolius* subsp. *polygonoides* (Moq.) Thell. var. *latifolius* Aschers. et Graebn. Syn. Mitteleur. Fl. 5 (1):308,1919.

Type

Nevski refers to Wight's Icones Indiae Orientalis 2, par. IV, tab 719 and herb. no. 6909. There is a specimen collected from South India by Wight and bearing the number 6909 in the herbarium of Komarov Botanical Institute, Leningrad. The label in Wight's handwriting reads as *Amaranthus polygamus* L. and there is a question mark after the name. On this specimen another label in Nevski's hand writing reads *Amaranthus polygonoides* Roxb. non L. and below this in bracket is written *A. roxburghianus* N. This becomes the type of the taxon.

There is a rigid erect or ascending plant with smaller and linear or linear oblong rigid leaves which is treated as a variety of *A. polygamus* by Hooker f. Fl. Brit. India 4:721, 1885. A new combination becomes necessary.

Amaranthus roxburghianus Nevski var *angustifolius* (Moq.) N.C. Nair comb. novo. *A. blitum* Linn. var. *angustifolia* Moq. in DC. Prodr. 13(2):263, 1849. *A. polygamus* var. *angustifolia* Hook. f. Fl. Brit. India 4:721, 1885. *A. angustifolius* Lamk. subsp. *polygonoides* Thell. var. *angustissimus* Thell. in Aschers. et Graeb. Syn. Mitteleur. Fl. 5(1): 309, 1919. *A. polygonoides* var. *angustifolia* (Hook. f.) N.C. Nair in Bull. (Hook. f.) N. C. Nair in Bull. Bot. Surv. India 8(1): 88, 1967.

Wight (Ic. 2:8, t. 512, 1843) figures another plant under the name *A. polygonoides.* Although called by that name, Wight (loc. cit., 6, 1843) expressed the view that it is not *A. polygonoides* of Linnaeus and Roxburgh but an intermediate between *A. polygonoides* and *A. tristis.* Hook. f. (loc. cit.) treated it under *A. polygamus* and considered that Wight's Ic. 2:8, t. 719 refers to the same plant. This plant, also, like *A. roxburghianus* Nevski, has three tepals and a corresponding number of stamens but is different from the latter in leaf and capsule. It has been treated by Thellung as a distinct species (see below) and later he reduced (see below) it to a sub-species of *A. angustifolius* Lamk. Nevski (loc. cit., 311, 1937) upheld its specific rank. This taxon is very closely related to *A. roxburghianus* Nevsky and intermediate forms are common. On these grounds it appears best to treat it only as a variety of *A. roxburghianus* Nevski.

Amaranthus roxburghianus Nevski var. *aschersonianus* (Thell.) N. C. Nair stat. novo. *A. aschersonianus* Thell. in Aschers. et Graebn. Syn. Mitteleur. Fl. 5:309, 1914; Nevski loc. cit. 311, 1937. *Euxolus polygamus* Moq. in DC. Prodr. 8(2): 272, 1849. *A. polygonoides* Wight, Ic. 2, t. 512, 1843 (non Linn., non Willd., non Roxb. & non Wight, t. 719). *A. angustifolius* Lam. subsp. *aschersonianus* Thell. in Aschers. et Graebn. Syn. Mitteleur. 5:309, 1919.

Closely resembling the above taxa is another plant which has also gone under the name

of *Amaranthus polygamus*. This is *Amaranthus lividus* Linn. subsp. *polygonoides* (Moq.) Probst. Wolladventivfl. Mitteleur. 74, 1949; Brenan, Watsonia 4(6):275, 1961. *Euxolus viridis* (Linn.) Moq. var. *polygonoides* Moq. in DC. Prodr. 13(2): 274, 1859. *A. ascendens* Lois. var. *polygonoides* Thell. ex EHL. Krause in Mittheil Philom. Ges. Els.-Lothr. 4(3), 1910 S. 372, 1911 fide Thell. in Aschers. et Graebn. Syn. Mitteleur. 5:320, 1914. *A. lividus* Linn. var. *polygonoides* (Moq.) Thell. in Aschers. et Graeb. Syn. Mitteleur. 5:320, 1919 (as var. *Zollinger* Thell.). *A. ascendans* Lois. subsp. *polygonoides* (Moq.) Priszter, Ann. Sect. Horti et Viticult. Univ. Sci. Agric. Budap. 221, 1953.

This plant also is common in India and is found often mixed up with collections of *A. roxburghianus*. It is a common weed of cultivated places and can be distinguished by the following characters:-

Small monoecious herbs with glabrous stems; leaves emarginate or subtruncate; longer bracteoles of female flowers about half as long as the flowers; tepals 3, obtuse; fruit not circumsessile, about 1½ times longer than the tepals, and seed almost filling the cavity (*see* Bennet *J. Bombay nat. Hist. Soc. 68*:491, 1971).

Acknowledgements

I am thankful to the authorities of Komarov Botanical Institute Leningrad, U.S.S.R., where this work was carried out under the Indo-Soviet Cultural and Scientific Exchange Programme, for facilities. I am also thankful to Dr. K. Subramanyam, former Director, Botanical Survey of India for his interest.

Spawning biology of tor mahseer, *Tor tor* (Ham.)[1]

S. K. Chaturvedi[2]

(*With four text-figures*)

Mahseers, the large-scaled Indian Carps, well known as excellent sport fish as well as food fish, have engaged the attention of naturalists, anglers and biologists from very early times. Their breeding habits have been a matter of much debate and the spawning of different types of Mahssers from various places having different climatic conditions has been studied. Nevertheless, nothing has been known about the Mahseers of Rajasthan where the ecological conditions are much different. Large Mahseers, *Tor tor* (Ham.) and *Tor khudree* (Sykes) abound in the lakes and rivers of southern and eastern Rajasthan forming an important fishery in some of the lakes. David (1953) and recently Kulkarni (1970) highlighted the value of Mahseers in pisciculture and in the recent years Mahseers have been transplanted in other parts of the State. Therefore, in view of the increased attention being paid to the development of the Mahseer stocks in Rajasthan, it was felt imperative to study their spawning habits in this area. The present paper deals with various aspects of the spawning biology of *Tor tor* (Ham.).

Materials and methods

The preliminary observations were started in 1964, but bulk of the material for this study was collected by cast and gill nets during the period August 1968 to June 1972 from Udaipur lakes and connected streams, already described by Dhawan (1969). The measurements of length, weight, observations on sex, weight and extent of gonads in the body cavity, stage of maturity etc. were taken from fresh specimens. To determine fecundity and ova diameter frequencies, the ovaries were preserved in Simpson's (1951) modification of Gilson's fluid.

Test measurements of ova from different parts of the ovary revealed that the progression of ova development throughout the ovary was not differential and ova were found evenly distributed throughout the ovary. However, to obviate any possibility of error egg samples were taken from different regions of both the ovaries. Randomized samples of 500 ova from each mature ovary were studied for ova diameter frequencies by the method followed by Clark (1934) and Prabhu (1956) using an ocular micrometer (1 m.d. = 0.043 mm). Immature ova smaller than 5 m.d. were not taken into account for this purpose.

For fecundity studies a small sample of 1.0 gm was taken, ova teased out of the follicles and counts were made of all ova comprising the mature group. The fecundity was estimated by multiplying the ova count per gram of

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ovary by the total weight of the ovary.

Length-weight relationship

250 females and 136 males ranging in length from 200-730 mm and 220-750 mm respectively, were measured and weighed. The sex of specimens below 200 mm length could not be reliably determined and hence they were not included in these calculations. The average weight for each 10 mm length interval was taken and the logarithmic values of these

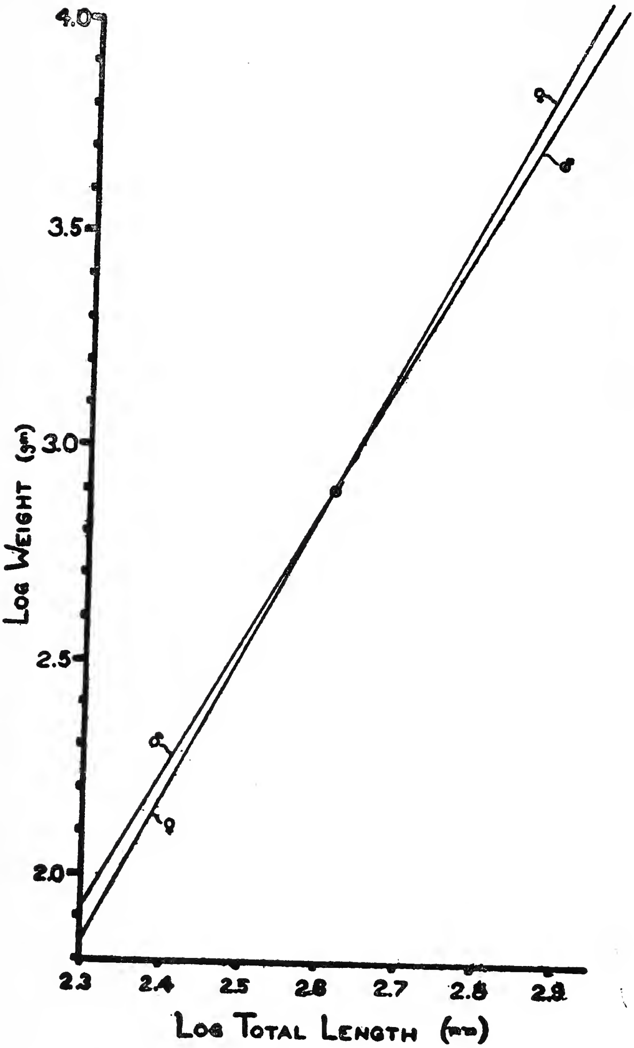

Fig. 1. Logarithmic relation of length and weight of males and females of Tor Mahseer.

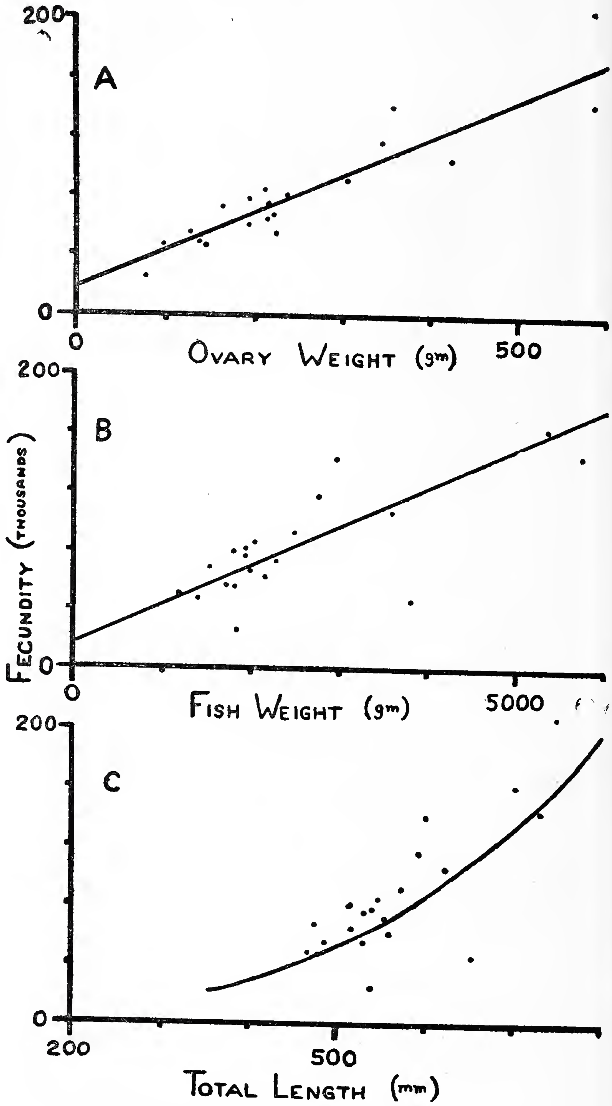

Fig. 2. Fecundity of Tor Mahseer in relation to ovary weight, body weight and total length.

length and weights computed. The length weight relationship was derived by applying the least-spares linear regression formula to the logarithmic transformation of the basic formula $W = aL^b$ (Where W is the weight of fish in grams and L the total length of millimetres for females and males separately. The resulting values can be expressed logarithmically as:

(i) $\text{Log } W = -5.9528 + 3.3927 \text{ Log } L$, for females.

(ii) $\text{Log } W = -5.3477 + 3.1609 \text{ Log } L$, for males.

Fig. 1 depicts the length-weight relationships and Table 1 shows the computed weights of males and females of similar length based on the above equations. It will be observed that length-weight relationship curves for males and females (though not significantly different) intersect at approximately 408 mm in total length, and though the males upto 400 mm were heavier than the females of the same size, the females were heavier amongst fish of larger size. It suggests that somewhere near 400 mm in total length the female overtakes the male in the weight, probably due to the heavier female gonads.

Table 1

Weights of females and males of corresponding length

Total length (mm)	Wt. of females (gm)	Wt. of males (gm)
200	71	84
300	283	304
400	750	754
500	1600	1526
600	2970	2716
700	5009	4420
800	7879	6741

Size at first maturity

For this purpose the specimens with gonads in the mature stages were observed during the beginning of the spawning season. The smallest mature female was encountered at 322 mm total length. All females below 320 mm size were found immature and most of the females above 390 mm were found mature. Hence it may be stated that the average size at first maturity lies between 320-390 mm. The size at first maturity is rather a constant proportion of the final length attained by a species—Holt (1962). Tor Mahseer is said to attain a maximum length of about 1200 mm Hora (1940) and MacDonald (1948) but in the present investigation the maximum length recorded was 757 mm only. Hence the ratio of the mean length at maturity to the asymptotic length is found to be *c.* 0.5.

The smallest mature male was observed at 254 mm total length and all males above 310 mm were found mature. The males, therefore, appear to mature at a relatively smaller size.

Since an average growth of about 350 mm is attained in one year (as evidenced from stocked fish seed in a nearby tank) it may be stated that both sexes can attain maturity by the end of the first year of their life. This is further confirmed by the fact that the immature fishes did not occur throughout the year. It was also noted that the smaller females which were apparently ready to spawn for the first time matured in the later part of the spawning season. This ensures almost a full year of growth before first spawning.

Sex ratio

During the period of investigation about 400 adult specimens were sexed by internal examination. Although both the sexes were represent-

ed in equal proportions during July-September an overall male: female ratio of 1:1.9 was indicated, i.e. the females greatly exceeded males in number. Table 2 gives the percentage of each sex in different size groups. It could be seen that there were more males than females amongst smaller group, but with the increase in size (and hence age) females become more abundant. Codrington (1946) and MacDonald (1948) made similar observations. Bennet (1962) also noted that this pattern was common in fish populations, presumably due to a higher mortality rate among the males. But this may also be due, in part, to gear selectively on account of girth differences in the two sexes.

TABLE 2

PERCENTAGE OF EACH SEX IN DIFFERENT SIZE GROUPS

Class range	Females	Males
250-299	15.78	84.22
300-349	41.51	58.49
350-399	37.20	62.80
400-449	46.43	53.57
450-499	73.17	26.83
500-549	80.32	19.68
550-599	85.71	14.29
600-649	87.17	12.83
650-699	100.00	0.0
700-749	90.00	10.00
750-799	100.00	0.0

SEX DIMORPHISM

In the males the pectoral fin extends to the seventh scale below the lateral line, while in females it is shorter, reaching below the fifth or sixth scale of the lateral line. Besides this, in the females the bulkiness of the abdomen gives rise to an arched ventral profile and the base of the anal fin projects out of profile line, whereas in the males the profile is comparatively less arched and the base of the anal fin does not as much project out of the profile line. There appeared to be no difference in the colours of the two sexes, and roughness of the pectorals was not felt even in the ripe males.

Almost similar characters to distinguish sexes in *Tor khudree* have been observed by Kulkarni (1970).

MATURITY STAGES

The gonads are paired, elongated organs suspended one on each side from the dorsal wall of the body cavity. These become progressively enlarged as the fish attain sexual maturity. Accordingly, certain stages have been identified for males and females separately.

(a) *Females*:

On the basis of macroscopic and microscopic examination seven stages of maturity were demarcated, which nearly correspond to those of International scale, Wood (1930). The peculiar features of these seven stages are given below:

I. Immature—

Ovaries small, thin, extending about half the length of the body cavity. Pinkish translucent. Ova not visible to the naked eye; mean ova diameter ranging from 2-4 m.d., with prominent nucleus and no yolk granules. The relative weight to body weight normally below 0.8 per cent.

II. Developing—

Early maturing or recovered spent in resting condition: Ovaries extending more than half the length of the body cavity. Pinkish or flesh coloured. Some ova visible to the naked eye. Few yolk granules present. Mean ova diameter ranging from 4 to 10 m.d.

III. Maturing—
Maturing fish: Ovaries extending about two-third length of the body cavity. Creamy white or yellowish in colour. Ova opaque, mean diameter ranging from 10 to 18 m.d.

IV. Maturing—
Advance maturing fish: Ovaries enlarged, occupying three-fourth length of the body cavity. Yellowish in colour. Ova opaque, larger ova fully yolked; mean ova diameter ranging from 18 to 28 m.d.

V. Mature—
Mature fish, but not running. Ovary extending to the entire length of body cavity. Ova bright yellow, fully yolked, opaque or transluscent, with transparent periphery, mean diameter ranging from 28 to 42 m.d.

VI. Ripe—
Spawning in progress or just imminent; large, free, spherical, more or less transparent ova, lemon yellow in colour: Ova can be extruded on slight pressure; Ovaries may form upto 16 per cent of the body weight.

VII. Spent—
Ovary small, loose and flaccid; reddish in colour, wholly or partly. Few remnants of ripe ova seen in the lumen of ovaries.

(b) *Males*:
On the basis of macroscopic examination, only five stage were identified.

I. Immature—
Testes small, thin pinkish strands extending to about one-third length of body cavity. Form upto 0.5 per cent of the weight of the fish.

II. Developing—
Developing virgin or spent resting: Pinkish translucent or fleshly opaque in colour. Thicker, more elongated, extending to about half the length of body cavity.

III. Maturing—
Testes enlarged, lobed, medium-sized. Pinkish white in colour; extend to about two-third of the length of body cavity.

IV. Mature—
Testes massive in appearance, extending over the entire length of the body cavity. Whitish-pink. Milt oozes out on slight pressure on the abdomen or even while handling. May form upto 9.5 per cent of the body weight.

V. Spent—
Testes shrunken, loose and flabby; extending to more than half of the length of the body cavity.

Fecundity

The fecundity of 23 mature females ranging from 465 mm to 740 mm in total length was estimated. The data are presented in Table 3.

Table 3
Average fecundity estimates at various size ranges

Length Range	Av. length (mm)	Av. Wt. (gm)	Av. Wt. of ovary (gm)	Av. No. of ova	No. of ova Per gm Wt. of fish	No. of ova Per gm. Wt. of ovary
400-500	472	1402	145.5	49,146	35.07	336.6
500-600	546	2155	217	78,340	36.35	361
600-700	655	4220	401	103,882	24.61	259
700-800	732	5950	577.5	175,886	29.56	304.3

The average fecundity ranged from 49,146 to 1,75,886, the number of ova per gram weight of ovary from 259 to 361 and the number of ova per gram weight of fish from 24.61 to 36.35. The following relationships with fecundity were also determined, (F denotes fecundity in thousands of ova) and are shown graphically in Fig. 2.

Fecundity and Ovary Weight:

A least-squares linear regression was used to fit a straight line equation to the relationship between the ovary weight and the fecundity. It showed a high degree of positive correlation ($r = 0.8931$), the relationship being,

$F = 17.66 + 0.2578\ W$

Where W = the ovary weight in grams.

Fecundity and Body Weight:

Least square regressions were carried out on both the observed values for fecundity and fish weight, and on their longarithmic equivalents, the latter to test for an exponential relationship. The equations that resulted are given below:

$F = 15.49 + 0.02637\ W$ ($r = 0.802$)

$\text{Log } F = 1.1170 + 0.8858 \log W$ ($r = 0.714$)

Where W = the total fish weight in grams.

The application of the z-test (Fisher 1958) showed no significant difference in the correlation coefficients (5% level). Although the sample is relatively small, this suggests that the simple linear relationship is sufficiently accurate. It also has the advantage of being easier to calculate for routine work. The equation for the exponential relationship, however, suggests that the relative fecundity may decrease with increasing fish weight. Additional data are needed to check this possibility.

Fecundity and Total Length:

As the relationship between fecundity and total length of fish was expected to be exponential, a least-squares regression on the logarithmic values was carried out. The equation for the resultant line, given below show a fairly high degree of correlation ($r = 0.666$)

$\text{Log } F = -5.6527 + 2.7381\ L.$

Where L = total length of fish in mm.

Spawning Periodicity

Many workers, Clark (1934), Hickling & Rutenberg (1936), Prabhu (1956), Qasim & Qayyum (1961), have determined the spawning periodicities of fishes by the studies of ova diameter frequency distributions from ovaries in the ripe or penultimate stage of the ovaries. The frequency distribution of the intra-ovarian eggs from 32 mature Mahseers was, therefore, studied. Since separate polygons drawn from individual fishes, even of different years, showed no difference in the pattern of ova diameter frequencies, no variation in the spawning periodicity between individuals was indicated. Hence the pooled frequency distribution of the intra-ovarian eggs have been depicted in Fig. 3 with the diameters divided into 5 m.d. groups.

From Fig. 3 it can be seen that the ova fall into two distinct groups. Group 'a' is the stock of undifferentiated ova that are present in the ovary throughout the year; group 'b' is completely separated from 'a' and represents the stock of ova that will ripen and be spawned. There is no evidence of any secondary modes of differentiated ova. Hickling & Rutenberg (1936) and Prabhu (1956) have stated that the presence of such a single well defined group of mature ova, fully differentiated from the immature stock indicates a short and definite spawning period for the particular species. It is, therefore, quite likely that Tor Mahseer spawns once a year during a short spawning period. Supporting evidence is obtained from the seasonal changes in the gonads, and the availability of spawners only during a definite period.

SPAWNING

In order to determine the spawning season of *Tor tor,* the monthly percentage of females in different stages of maturity were determined. The immature fishes were not considered for this purpose. It could be seen that the fishes in developing stage were maximum in the samples obtained during October to February every year. Stage III fishes were first encountered in February and the maturing specimens (Stage III and IV), predominant during April-May, occur till July. Mature (Stage V) females started appearing in May and gradually in-

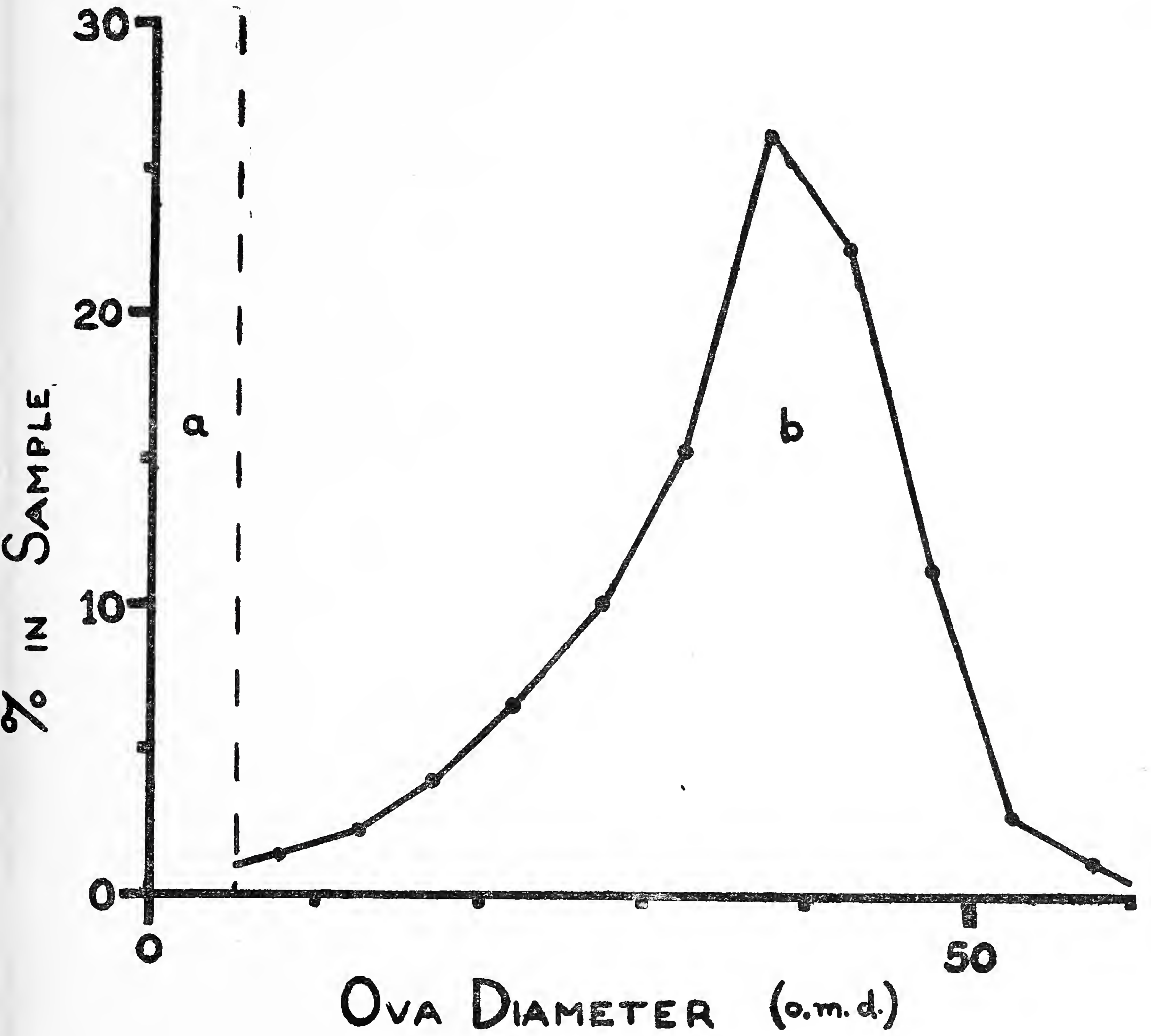

Fig. 3. Frequency distribution of ova in Tor Mahseer.

creased in proportions from June onwards. The majority of the females during July-September were mature or ripe, with its peak in August. The spent females first appeared in August and were recorded till October. The resorbing or spent recovering stages were occasionally observed during November and December.

Amongst the males also, only the earliest stages were found during October to February. The maturing specimens started appearing from March onwards and, during July-September the majority were in ripe or oozing condition. Spent males were observed in large numbers in September-October.

The Gonado-Somatic Index (gonad weight as % of body weight) also exhibits a similar cycle of seasonal changes. Fig. IV depicts monthly mean values of index for females and males separately. It could be seen that in the females the index values were very low during January-February. The values gradually increase in March, commencing a sharp rise in April to its peak in August. The sharp ascending limb of the curve occurred due to ripe females. This rise is followed by a decline in September due to spawning, reaching its lowest level in October represented by specimens mostly in spent or resting condition. A nominal increase in the index values in seen in November-December due to spent-recovering specimens.

The seasonal fluctuations of gonado-somatic index in the males was less marked, but showed a similar trend. There was the gradual increase in index values from April onwards, the index was high in July, reached its peak in August and then declined in September as there were a large number of spent males in the samples.

It can, therefore, be inferred from the monthly changes in the gonads that *Tor tor* breeds only once a year during a breeding season that extends from July to September, with its peak in August. Young fry collected only during August-September in large numbers further confirm it.

Discussion

Day (1873), Beavan (1877), Nevill (1915) and Sken-Dhu (1918) found that Mahseers breed several times in a year. Thomas (1897) recorded that they breed during the post-monsoon month and lay eggs in batches. Hora & Mukerjee (1936) and Hora (1939, 1940) observed that *Barbus* (*tor*) *putitora, Barbus*(*tor*) *tor* and *Barbus* (*tor*) *mosal* breed sometimes in August-September in the Himalayan rivers. Hora & Misra (1938) opined that *B.* (*tor*) *khudree* breed in August-September in Deolali hills. MacDonald (1948) states: "the putitor Mahseer is said to spawn three times in a year. In the Punjab, the three spawning seasons are (1) Jan.-Feb. (2) May-June and (3) July-September." Nazir Ahmed (1948) observed the breeding season of Assam Mahseer, *B.* (*Lissochilus*) *hexagonolepis* extending from April October with peak in August-September, whereas David (1953) dealing with Mahanadi Mahseer, *B.* (*tor*) *mosal mahanadicus* stated, "the breeding takes place only during the post monsoon period between October and November". He also found that in *B.* (*tor*) *khudree* and *B.* (*tor*) *musallah* spawning takes place in November in the cauvery system. Qasim and Qayyum (1961) reporting on *B.* (*tor*) *putitora* from Aligarh stated, "the species may spawn several times over a greater part of the year". Karamchandani observed that breeding season of *Tor-tor,* from Narmada river commences in July-August and continues upto December. Recently Kulkarni (1970) observed a fortnight or two between late July and early August as the peak breeeding season of *Tor khudree* in

lakes near Poona.

Mahseers, therefore, appear to have a varied breeding seasons and according to many workers the spawning is prolonged even upto December. During the present investigation also a few large females in the maturing stages have been captured during November and December. Since it has been observed that the large specimens generally spawn earlier in the season, these might be the spent-recovered individuals and though it may lead one to think that these maturing females may mature and spawn soon it need not necessarily follow. Jones (1946) says "Fertilisable eggs in the ovary and presence of developing embryos and young fry in the waters inhabited by the fishes alone should, as far as possible, be taken as the proper criterion for judging the exact breeding period." Although the intensive sexual activity of carps and their capture with comparative case is well

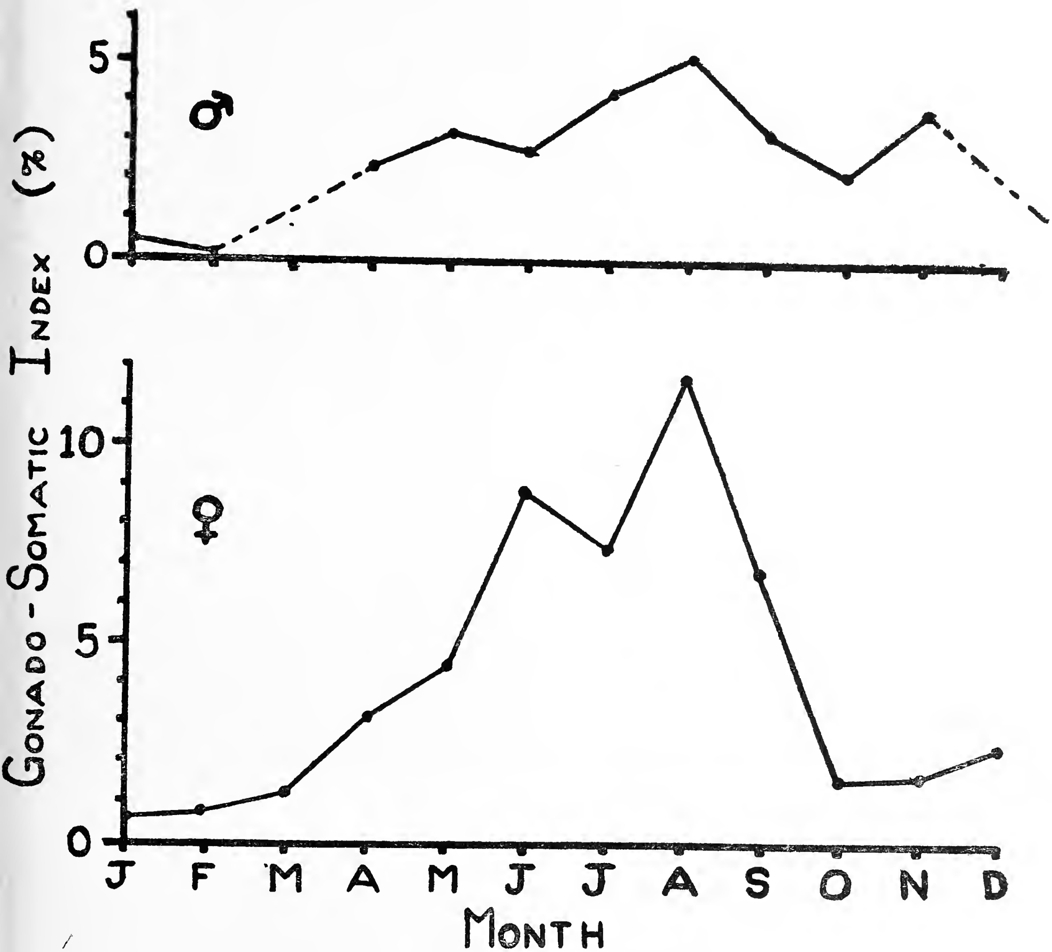

Fig. 4. The gonado-somatic index of males and females during different months.

known, no ripe males or females have been captured during October to March. Young fry are also altogether wanting during November to June. Hence the occurrence of a few maturing females during Nov.-Dec. may be better treated as exceptional and the possibility of breeding from October until the initial rains in June-July is altogether excluded. From all available evidence, it is clearly established that *Tor tor* spawns only once a year during July to September, with its peak in August.

Factors affecting spawning

In Indian Major carps, flood waters caused by rainfall or artificial means capable of inundating shallow areas are essential to induce spawning, Alukunhi & Rao (1951); Khanna (1958). Temperature is the other factor which has been found to affect the spawning of fishes Khan (1945); Das & Das Gupta (1945). The Mahseer prefers clean water and its migratory habits for breeding purposes are well known, Codrington (1946). In the Punjab, Mahseer is reported to spawn first in winter, secondly in May-June when the snow melts and rivers are swollen and thirdly from July to September when the rivers are flooded with the monsoon rains MacDonald (1948). David (1953) stated. "It would thus appear that optimum conditions for breeding are reached when the temperature is agreeable.... as in the relatively cooler waters of the Deccan plateau in the winter months."

The above observations strongly suggest that the flood of clear water accompanied by drop in temperature is the essential prerequisite for spawning of Mahseers. In the study area, the only significant rains occur with the south-west monsoon which may commence as early as late June and usually lasts upto September. After saturation and flushing by the initial rains the streams get flooded, low lying areas inundated, flow of clear water is made available and the temperature is lowered. But the exact timing of these optimum conditions for spawning is variable, because the rains are often erratic. The preceding observations on the monthly changes in the gonads, ova-diameter frequencies and the conditions of the maturity of the population demonstrate that the gonads in *Tor tor* are specifically adopted to cope with much variability and the availability of mature fishes during July-September ensures that there will always be some ready to spawn as soon as the optimum conditions prevail. As these conditions are likely to be best available in the later part of the rains only, the peak spawning is found to occur in August.

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Catalogue of Indian Tingidae (Hemiptera)[1]

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The only consolidated work on the Indian Tingidae is by Distant (1903b & 1910) in which he has described 31 genera including 56 species. Distant (1903b) placed twenty genera in three divisions namely Cantacaderaria, Serenthiaria and Tingidaria. In 1910 Distant added nine more genera to these divisions and formulated two more divisions Axiokersosaria and Aidoneusaria each for the genus *Axiokersos* and *Aidoneus* respectively. Menon & Hakk (1959a) considered these five divisions as subfamilies and created a new subfamily Phyllogasterotinginae to include a genus *Phyllogasterotingis* which actually belongs to the family Coreidae. According to the recent classification (Drake & Ruhoff 1965), the family Tingidae is divided into three subfamilies: Cantacaderinae, Tinginae and Vianaidinae. The subfamily Cantacaderinae includes two tribes: Cantacaderini and Phatnomini; Tinginae includes three tribes: Litadeini, Tingini and Ypsotingini while Vianaidinae is represented by only two genera. The divisions Serenthiaria, Axiokersosaria and Aidoneusaria are considered synonyms of Tinginae. The tribe Litadeini and subfamily Vianaidinae are unrepresented in India. Since the publication of the Distant's FAUNA OF BRITISH INDIA including Burma and Ceylon, several changes have taken place in the taxonomic status of the already known taxa. Moreover many additional genera and species have been described from India in scattered publications. According to the present state of knowledge the family is represented by 49 genera and 107 species in the Indian fauna. An attempt has been made to bring together all the taxonomic changes in the present publication to facilitate further work on the taxonomy of the family Tingidae.

Family TINGIDAE Laporte
Subfamily Cantacaderinae Stal
Tribe CANTACADERINI Stal

Genus *Cantacader* Amyot & Serville

Cantacader Amyot & Serville 1843; Distant 1903b. *Taphrostethus* Fieber 1844. Type species: *Piesma quadricornis* Le Peletier & Serville.

Cantacader diffidentis Drake & Poor 1936. Type: Dehra Dun.

Cantacader infuscatus Distant 1903b. Type: British Museum.

Cantacader quinquecostatus (Fieber)

Taphrostethus quinquecostatus Fieber 1844; Walker 1873b.

Cantacader quinquecostatus Distant 1903b, 1910. Type: Unknown.

Cantacader uniformis Distant 1902, 1903b. Type: British Museum.

Tribe PHATNOMINI Drake & Davis
Genus *Gonycentrum* Bergroth

Gonycentrum Bergroth 1898; Distant 1903b. *Teleia* Fieber 1844; Walker 1873b. *Sinalda* Distant 1904. Type species: *Teleia coronata* Fieber.

Gonycentrum coronatum (Fieber)

Teleia coronata Fieber 1844; Stal 1873. *Gonycentrum coronatum* Distant 1903b. Type: Unknown.

[1] Accepted November 1972.

Genus *Malala* Distant

Malala Distant 1910. Type species: *Malala bulliens* Distant.

Malala bulliens Distant 1910. Host: Tobacco. Type: British Museum.

Genus *Phatnoma* Fieber

Phatnoma Fieber 1844; Walker 1873b. Type species: *Phatnoma laciniata* Fieber.

Phatnoma laciniata Fieber 1844; Stal 1873; Distant 1903b. Type: Unknown.

Phatnoma takasago Takeya 1933; Drake & Poor 1939. Host *Lantana* sp. Type: Kyushu Univ.

Phatnoma togularis Drake 1950. Type: Dehra Dun.

(*Phatnoma costalis*: not yet recorded from India)

Subfamily Tinginae Laporte

Tribe TINGINI Laporte

Genus *Abdastartus* Distant

Abdastartus Distant 1910. Type species: *Abdastartus tyrianus* Distant = *Monanthia atra* Motschulsky.

Abdastartus atrus (Motschulsky)

Monanthia atra Motschulsky 1863. *Teleonemia atra* Distant 1903b. *Abdastartus tyrianus* Distant 1910. *Abdastartus atrus* Drake 1956a. Type: Moscow Univ.

Abdastartus longulus Drake 1953a. Type: Dehra Dun.

(*Abdastartus tyrianus* = *Abdastartus atrus*)

Genus *Aconchus* Horváth

Galeatus (*Aconchus*) Horváth 1905. *Aconchus* Horváth 1906a. Type species: *Galeatus* (*Aconchus*) *urbanus* Horváth.

Aconchus urbanus (Horváth)

Galeatus (*Aconchus*) *urbanus* Horváth 1905. *Aconchus urbanus* Horváth 1906a. Type: Paris Museum.

Genus *Agramma* Stephens

Agramma Stephens 1829. *Serenthia* Spinola 1837. *Wombalia* Schouteden 1919. *Drakea* Schouteden 1953. Type species: *Tingis laeta* Fallén.

Agramma gibbum Fieber

Agramma gibba Fieber 1844. *Serenthia gibba* Stal 1873; Distant 1903b. Type: Vienna Museum.

Agramma hupehanum (Drake & Maa)

Serenthia hupehanum Drake & Maa 1954. *Agramma hupehanum* Drake & Ruhoff 1965. Type: California Academy of Sciences.

Agramma scitulum Drake & Maa 1955. Type: United States National Museum.

Genus *Aidoneus* Distant

Aidoneus Distant 1909, 1910. Type species: *Aidoneus dissimilis* Distant.

Aidoneus dissimilis Distant 1909, 1910. Type: British Museum.

Genus *Ammianus* Distant

Ammianus Distant 1903b, 1910. *Monanthia* Fieber 1844 (In part). *Phyllontochila* Stal 1873 (In part). *Sakuntala* Kirkaldy 1902. *Phyllontocheila* Horváth 1911. Type species: *Monanthia* (*Phyllontocheila*) *erosa* Fieber.

Ammianus erosus (Fieber)

Monanthia (*Phyllontocheila*) *erosa* Fieber 1844. *Tingis erosa* Walker 1873a. *Phyllontocheila erosa* Stal 1873, Distant 1920. *Ammianus erosus* Distant 1903b. Type: Vienna Museum.

Ammianus ravanus (Kirkaldy)

Sakuntala ravana Kirkaldy 1902. *Phyllontocheila ravana* Distant 1903a, 1910. *Ammianus ravanus* Drake 1957b. Host: *Vitrex trifolia*. Type: Unknown.

Genus *Axiokersos* Distant

Axiokersos Distant 1909, 1910. Type species: *Axiokersos ovalis* Distant.

Axiokersos ovalis Distant 1909, 1910. Type: Z.S.I., Calcutta.

(Genus *Ayrerus* Distant is a synonym of *Urentius*)

Genus *Baeochila* Drake & Poor

Cysteochila (*Baeochila*) Drake & Poor 1937b. *Baeochila* Drake 1948c. Type species: *Cysteochila elongata* Distant.

Baeochila dehrana Drake & Maa 1954. Type: United States National Museum.

Baeochila elongata (Distant)

Cysteochila elongata Distant 1903a, 1903b. *Baeochila elongata* Drake 1948c. Type: British Museum.

Baeochila nexa (Distant)

Cysteochila nexa Distant 1903a, 1903b. *Baeochila nexa* Drake & Ruhoff 1960b. Type: British Museum.

Genus *Bako* Schouteden

Bako Schouteden 1923. *Galeotingis* Drake 1947. Type species: *Bako lebruni* Schouteden.

Bako malayanus (Drake)

Galeotingis malayanus Drake 1947. *Bako malayanus* Drake 1954b, Drake & Mohanasundarum

1961. Host: *Panicum repens; Cynodon dactylon; Cenchrus glaucus*; *Oriza sativa*. Type: United States National Museum.

Genus *Belenus* Distant

Belenus Distant 1909, 1910. Type species: *Monanthia dentatus* Fieber.

Belenus bengalensis Distant 1909, 1910. Type: British Museum.

Belenus dentatus (Fieber)
Monanthia (*Phyllontocheila*) *dentata* Fieber 1844. *Phyllontocheila dentata* Stal 1873, Distant 1903b. *Belenus dentatus* Distant 1909, 1910.
(*Belenus angulatus*: not yet recorded from India.)
(Genus *Bredenbachius* is a synonym of *Cysteochila*) *Bredenbachius pictus* = *Cysteochila pictus*: not yet recorded from India.

(Genus *Cadamustus* is a synonym of *Stephanitis* Stal) *Cadamustus typicus* = *Stephanitis typica*. *C. suffusus* = *S. suffusus*: not yet recorded from India.
(Genus *Cadmilos* is a synonym of *Galeatus*) *Cadmilos retiarius* = *Galeatus scrophicus*.

Genus *Celantia* Distant

Celantia Distant 1903b. Type species: *Leptodictya vagans* Distant.

Celantia teres Drake (emendation)
Celantia teretis Drake 1951. Type: Hungarian Museum.
(*Celantia vagans*: not yet recorded from India).

Genus *Cochlochila* Stal

Monanthia (*Cochlochila*) Stal 1873. *Cochlochila* Horváth 1910. *Physodictylon* Lindberg 1927. Type species: *Monanthia* (*Cochlochila*) *bullita* Stal.

Cochlochila bullita (Stal)
Monanthia (*Cochlochila*) *bullita* Stal 1873. *Tingis globulifera* Walker 1873a. *Monanthia globulifera* Distant 1902, 1903b, 1910; Maxwell-Lefroy 1909; Fletcher 1918, 1920; Iyengar 1924; Singh 1953; Sharga 1953. *Cochlochila bullita* Horváth 1909. Host: *Coleus, Ocimum basilicum, Ocimum sanctum*, sage, mint and safflower. Type: Unknown.

Cochlochila nilgiriensis (Distant)
Monanthia nilgiriensis Distant 1903a, 1903b; Drake 1933; Singh 1953. *Cochlochila nilgiriensis* Drake 1948e. Host: *Tetcon grandis*. Type: British Museum.

Genus *Collinutius* Distant

Collinutius Distant 1903b. Type species: *Tingis alicollis* Walker.

Collinutius alicollis (Walker)
Tingis alicollis Walker 1873a; *Phyllontochila alicollis* Distant 1902; *Collinutius alicollis* Distant 1903b. Type: British Museum.

Genus *Compseuta* Stal

Monanthia (*Compseuta*) Stal 1873. *Compseuta* Distant 1904. Type species: *Tropidocheila ornatella* Stal.

Compseuta lefroyi Distant 1909, 1910. Host *Lantana* sp. Type: British Museum.

Genus *Corythauma* Drake & Poor

Corythauma Drake & Poor 1939. Type species: *Leptopharsa ayyari* Drake.

Corythauma ayyari (Drake)
Leptopharsa ayyari Drake 1933. *Corythauma ayyari* Drake & Poor 1939. Host: *Jasminum pubescens* and *Lantana* sp. Type: Presidency of Madras.

Corythauma varia Drake & Maa.
Corythauma ayyari var. *varia* Drake & Maa 1953. *Corythauma varia* Drake & Ruhoff 1962. Type: United States National Museum.

Genus *Cysteochila* Stal

Cysteochila Stal 1873; Distant 1903b. *Bredenbachius* Distant 1903a, 1903b. Type species: *Monanthia tingoides* Motschulsky.

Cysteochila ablusa Drake 1948a. Host: *Bauhinia variegata*. Type: United States National Museum.

Cysteochila annandalei (Distant)
Bredenbachius annandalei Distant 1909, 1910. *Cysteochila annandalei* Drake & Ruhoff 1965. Type: British Museum.

Cysteochila consanguinea (Distant)
Bredenbachius consanguineus Distant 1909, 1910. *Cysteochila consanguinea* Drake 1937b. Type: British Museum.

Cysteochila delineata (Distant)
Bredenbachius delineatus Distant 1909, 1910. *Cysteochila delineata* Drake 1933; Drake & Poor 1936; Singh 1953. Host: *Bauhinia purpurea*. Type: Z.S.I., Calcutta.

Cysteochila expleta Drake & Maa 1954. Type: British Museum.

Cysteochila fieberi (Scott)
Monanthia fieberi Scott 1874. *Cysteochila fieberi* Drake & Maa 1954. Type: British Museum.

Cysteochila humeralis (Distant)
Bredenbachius humeralis Distant 1909, 1910. *Cysteochila humeralis* Drake & Ruhoff 1965. Type: Z.S.I., Calcutta.

Cysteochila javensis Drake & Poor 1937b. Type: United States National Museum.

Cysteochila taprobanes Kirkaldy 1908; Distant 1910. Type: Unknown.

Cysteochila terminalis Drake 1948a. Type: United States National Museum.

Cysteochila tingoides (Motschulsky)
Monanthia tingoides Motschulsky 1863. *Cysteochila tingoides* Stal 1873; Distant 1903b; Drake 1948a. Type: Leningrad Museum.
Cysteochila elongata = *Baeochila elongata*
Cysteochila nexa = *Baeochila nexa*

Genus *Dasytingis* Drake & Poor

Dasytingis Drake & Poor 1936. Type species: *Dasytingis rudis* Drake & Poor.

Dasytingis rudis Drake & Poor 1936. Host: *Vitex negundo.* Type: United States National Museum.

Dasytingis semota Drake & Lutz 1953. Type: United States National Museum.

Genus *Diconocoris* Mayr

Diconocoris Mayr 1865. *Diplogomphus* Horváth 1906c. Type species: *Diconocoris javanus* Mayr.

Diconocoris nepalensis (Distant)
Elasmognathus nepalensis Distant 1909, 1910. *Diplogomphus nepalensis* Drake & Poor 1937a. *Diconocoris nepalensis* Drake 1937a. Type: Z.S.I., Calcutta.

Genus *Dictyla* Stal

Dictyla Stal 1874. *Monanthia* (of authors *nec.* LePeletier & Serville). Type species: *Monanthia platyoma* Fieber.

Dictyla cheriani (Drake)
Monanthia cheriani Drake 1936. *Dictyla cheriani* Drake & Ruhoff 1960a. Host: *Corida* sp. Type: United States National Museum.

Dictyla comes (Drake)
Monanthia comes Drake 1948a. *Dictyla comes* Drake & Ruhoff 1960a. Type: United States National Museum.

Dictyla eudia Drake & Quadri 1964. Type: United States National Museum.

Dictyla lupata (Drake & Poor)
Monanthia lupata Drake & Poor 1936. *Dictyla lupata* Drake & Ruhoff 1960a. Type: United States National Museum.

Dictyla serosa (Drake & Poor)
Monanthia serosa Drake & Poor 1937b; Maa 1957. *Dictyla serosa* Drake & Ruhoff 1960a. Type: United States National Museum.

Genus *Dulinius* Distant

Dulinius Distant 1903a, 1903b. *Sankisia* Schouteden 1916. Type species: *Dulinius conchatus* Distant.

Dulinius conchatus Distant 1903a, 1903b, 1910. Host: *Morinda* sp. Type: British Museum.

Genus *Elasmognathus* Fieber

Elasmognathus Fieber 1844; Stal 1873; Distant 1903b. Type species: *Elasmognathus helferi* Fieber.

Elasmognathus helferi Fieber 1844, Stal 1873, Distant 1903b. *Monanthia helferi* Walker 1873a. Type: Unknown.
Elasmognathus greeni = *Diconocoris greeni*: not yet recorded from India.
Elasmognathus nepalensis = *Diconocoris nepalensis.*

Genus *Eteoneus* Distant

Eteoneus Distant 1903b. Type species: *Serenthia dilatata* Distant.

Eteoneus sigillatus Drake & Poor 1936; Singh 1953. Type: United States National Museum.
Eteoneus dilatatus: not yet recorded from India.

Genus *Galeatus* Curtis

Galeatus Curtis 1833. *Cadmilos* Distant 1909, 1910. Type species: *Tingis spinifrons* Fallén.

Galeatus scrophicus Saunders 1876. *Cadmilos retiarius* Distant 1909, 1910. *Galeatus retiarius* Fletcher 1920. Host: *Chrysanthemum* sp. Type: British Museum.
Galeatus darthula = *Habrochila darthula.*

Genus *Habrochila* Horváth

Habrochila Horváth 1912a. Type species: *Habrochila placida* Horváth.

Habrochila darthula (Kirkaldy)
Galeatus darthula Kirkaldy 1902; Distant 1903b. *Habrochila darthula* Drake & Ruhoff 1961. Host: *Barleria strigosa.* Type: British Museum.

Habrochila laeta Drake 1954a. Type: British Museum.

Genus *Haedus* Distant

Haedus Distant 1904. *Hormisdas* Distant 1910. Type species: *Haedus clypeatus* Distant.

Haedus lectus (Drake)

Hormisdas lectus Drake 1937a. *Haedus lectus* Drake 1953a. Host: *Elephantia*. Type: Vienna Museum.

Haedus vicarius (Drake)

Hormisdas vicarius Drake 1927, 1936. *Haedus vicarius* Drake 1953a. Host: *Urena lobata*. Type: United States National Museum.

Genus *Hegesidemus* Distant

Hegesidemus Distant 1911. Type species: *Hegesidemus eliyanus* Distant.

Hegesidemus otiosus Drake 1953b.

Genus *Ildefonsus* Distant

Ildefonsus Distant 1910. Type species: *Ildefonsus provorsus* Distant.

Ildefonsus provorsus Distant 1910. Type: British Museum.

(Genus *Jannaeus* is a synonym of *Lasiacantha*)

Genus *Lasiacantha* Stal

Tingis (*Lasiacantha*) Stal 1873. *Lasiacantha* Stal 1874. *Jannaeus* Distant 1909, 1910. Type species: *Tingis* (*Lasiacantha*) *hedenborgii* Stal.

Lasiacantha altimitrata (Takeya)

Jannaeus altimitrata Takeya 1933. *Lasiacantha altimitratus* Drake 1953a. Type: Kyushu University.

Lasiacantha cuneata (Distant)

Jannaeus cuneatus Distant 1909, 1910; Drake & Poor 1936; Singh 1953. *Lasiacantha cuneatus* Drake 1953a. *Lasiacantha cuneata* Drake & Ruhoff 1965. Type: British Museum.

(Genus *Mokanna* is a synonym of *Stephanitis*)

(Genus *Monanthia* is a synonym of *Copium*)

Monanthia globulifera = *Cochlochila bullita*

Monanthia nilgiriensis = *Cochlochila nilgiriensis*

Monanthia fasciata = *Physatocheila fasciata*

Genus *Monosteira* Costa

Monosteira Costa 1864. Type species: *Monanthia unicornis* Mulsant & Ray.

Monosteira edeia Drake & Livingstone 1964. Type: United States National Museum.

Genus *Naochila* Drake

Naochila Drake 1957c. Type species: *Cochlochila boxiana* Drake.

Naochila arete Drake & Mohanasundarum 1961. Host: *Cordia* sp. Type: United States National Museum.

Naochila sufflata (Drake & Poor)

Monanthia sufflata Drake & Poor 1939. *Naochila sufflata* Drake & Ruhoff 1960b. Host: *Lantana* sp. Type: United States National Museum.

Genus *Paracopium* Distant

Paracopium Distant 1902, 1903b. Type species: *Dictyonota cingalensis* Walker.

Paracopium cingalense (Walker)

Dictyonota cingalense Walker 1873a. *Paracopium cingalensis* Distant 1902. *Paracopium cingalense* Distant 1903b. Maxwell-Lefroy 1909. Host: *Clerodendron phlomoides*. Type: British Museum.

Paracopium comatum Drake

Paracopium comantis Drake 1953b. *Paracopium comatum* Drake & Ruhoff 1965. Type: British Museum.

Paracopium lewisi: not yet recorded from India.

Genus *Perissonemia* Drake & Poor

Perissonemia Drake & Poor 1937a. Type species: *Perissonemia torquata* Drake & Poor.

Perissonemia bimaculata (Distant)

Teleonemia bimaculata Distant 1909. *Perissonemia bimaculata* Drake & Ruhoff 1961. Type: British Museum.

Perissonemia ecmeles Drake & Mohanasundarum 1961. Host: *Ficus* sp. Type: United States National Museum.

Perissonemia onerosa Drake & Poor 1939. Host: Sandal. Type: United States National Museum.

Genus *Phaenotropis* Horváth

Monosteira (*Phaenotropis*) Horváth 1906a. *Phaenotropis* Drake 1957a. Type species: *Monanthia* (*Monosteira*) *parvula* Signoret.

Phaenotropis cleopatra (Horváth)

Monosteira cleopatra Horváth 1905. *Phaenotropis cleopatra* Drake 1957a. Type: Vienna Museum.

Genus *Physatocheila* Fieber

Monanthia (*Physatocheila*) Fieber 1844. *Physatocheila* Stal 1873. *Phyllochisme* Kirkaldy 1904. Type species: *Acanthia quadrimaculata* Wolff = *Acanthia costata* Fabricius.

Physatocheila chatterjeei Drake & Poor 1936. Type: United States National Museum.

Physatocheila dryadis Drake & Poor 1936. Host:

Quercus dilatata. Type: United States National Museum.

Physatocheila exolasca Drake 1954a. Type: United States National Museum.

Physatocheila fasciata (Fieber)
Monanthia (*Physatocheila*) *fasciata* Fieber 1844. *Monanthia fasciata* Stal 1873; Distant 1903b. *Physatocheila fasciata* Drake 1937b. Type: Unknown.

Physatocheila gibba (Fieber)
Monanthia (*Physatocheila*) *gibba* Fieber 1844. *Monanthia gibba* Stal 1873. *Physatocheila gibba* Drake & Ruhoff 1960b. Type: Unknown.

Physatocheila lenis Drake & Poor 1939. Type: United States National Museum.

Physatocheila marginata (Distant)
Telonemia marginata Distant 1909, 1910. *Physatocheila marginata* Drake & Ruhoff 1965. Type: British Museum.
Phyllontochila ravana = *Ammianus ravanus*
P. dentata = *Belenus dentatus*.

Genus *Pontanus* Distant

Pontanus Distant 1902. *Teratochila* Drake & Poor 1936. Type species: *Monanthia gibbifera* Walker.

Pontanus puerilis (Drake & Poor)
Teratochila puerilis Drake & Poor 1936; Singh 1953. Host: Teak. Type: United States National Museum.

Genus *Recaredus* Distant

Recaredus Distant 1909, 1910. Type species: *Recaredus rex* Distant.

Recaredus rex Distant 1909, 1910. Z.S.I. Calcutta.
(Genus *Serenthia* is a synonym of *Agramma*)
Serenthia gibba = *Agramma gibbum*

Genus *Stephanitis* Stal

Stephanitis Stal 1873. *Cadamustus* Distant 1903a, 1903b, 1910. *Maecenas* Kirkaldy 1904. *Calliphanes* Horváth 1906b. *Mokanna* Distant 1910. Type species: *Acanthia pyri* Fabricius.

Stephanitis assamana Drake & Maa 1954. Type: British Museum.

Stephanitis assamana sub sp. *eremnoa* Drake & Ruhoff 1960b. Type: British Museum.

Stephanitis charieis Drake & Mohanasundarum 1961. Host: *Artocarpus integrifolia*. Type: United States National Museum.

Stephanitis gallarum Horváth 1906a; Distant 1910; Singh 1953. Host: *Machilus gamblei*. Type: Hungarian Museum.

Stephanitis princeps (Distant)
Mokanna princeps Distant 1910. *Stephanitis princeps* Horváth 1912b. Type: British Museum.

Stephanitis steeleae Drake & Maa 1954. Type: British Museum.

Stephanitis subfasciata Horváth 1912b; Drake 1948b. Type: Unknown.

Stephanitis takeyai Drake & Maa 1955. Type: Unknown.

Stephanitis typica (Distant)
Cadmustus typicus Distant 1903a, 1903b. *Stephanitis typicus* Distant 1910, Nagaraj & Menon 1956; Shanta, Menon & Pillai 1960. *Stephanitis typica* Fletcher 1920. *Stephanitis indiana* Drake 1948b. Type: United States National Museum.
Stephanitis sordidus: not yet recorded from India.

Genus *Tanytingis* Drake

Tanytingis Drake 1939. Type species: *Tanytingis takahashii* Drake.

Tanytingis assamana Drake & Lutz 1953. Type: United States National Museum.

Genus *Teleonemia* Costa

Teleonemia Costa 1864; Stal 1873. Type species: *Teleonemia funerea* Costa.

Teleonemia scrupulosa Stal 1873; Khan 1945; Roonwal 1952; Singh 1953. *Teleonemia lantanae* Beeson & Chatterjee 1940. Host; *Lantana aculeata*. Type: Unknown.

Teleonemia assamensis = *Ulonemia assamensis*.
Teleonemia atra = *Abdastartus atrus*.
Teleonemia marginata = *Physatocheila marginata*.

Genus *Tingis* Fabricius

Tingis Fabricius 1803. *Phyllontocheila* Fieber 1844 (in part); Distant 1903b. Type species: *Cimex cardui* Linnaeus.

Tingis agrana Drake & Livingstone 1964. Type: United States National Museum.

Tingis buddleiae Drake 1930. *Tingis himalayae* Drake 1948d. Host: *Vitrex trifolia*. Type: United States National Museum.

Tingis comosa (Takeya)
Dictyonota comosa Takeya 1931. *Tingis comosa* Drake 1948a. Type: Kyushu University.

Tingis consaepta Drake & Poor 1939. Type: United States National Museum.

Genus *Trachypeplus* Horváth

Trachypeplus Horváth 1926. Type species: *Trachy-*

peplus jacobsoni Horváth.

Trachypeplus jacobsoni Horváth 1926; Drake & Poor 1936; Singh 1953. Type: Unknown.

Trachypeplus malloti Drake & Poor 1936. Host: *Mallotus philippinensis.* Type: United States National Museum.

Genus *Ulonemia* Drake & Poor

Perissonemia (Ulonemia) Drake & Poor 1937a. *Ulonemia* Drake 1942b. Type species: *Perissonemia* (*Ulonemia*) *dignata* Drake & Poor.

Ulonemia assamensis (Distant)

Teleonemia assamensis Distant 1903a, 1903b. *Ulonemia assamensis* Drake & Ruhoff 1960b. Type: British Museum.

Genus *Urentius* Distant

Urentius Distant 1903b. *Ayrerus* Distant 1903b. Type species: *Urentius echinus* Distant = *Tingis hystricellus* Richter.

Urentius euonymus Distant 1909.

Urentius maculatus Drake 1933. *Urentius euphorbiae* Menon & Hakk 1959b (*nom. nud.*). Type: British Museum.

Urentius hystricellus (Richter)

Tingis hystricellus Richter 1869. *Ayrerus hystricellus* Distant 1903b. *Urentius echinus* Distant 1903b, Maxwell-Lefroy 1909; Fletcher 1920; Singh 1953; Patel & Kulkarny 1955. *Urentius olivaceus* Distant 1909, 1910. *Urentius sentis* Distant 1909, 1910. *Urentius hystricellus* Drake & Ruhoff 1960a. Host: *Solanum melongena*. Type: Unknown.

Urentius echinus = *Urentius hystricellus*

Urentius olivaceus = *Urentius hystricellus*

Urentius sentis = *Urentius hystricellus*

Urentius indicus Menon & Hakk 1959b (*nom. nud.*)

Urentius pusaensis Menon & Hakk 1959b (*nom. nud.*)

Urentius sidae Menon & Hakk 1959b (*nom. nud.*)

Urentius zizyphifolius Menon & Hakk 1959b (*nom. nud.*)

Tribe YPSOTINGINI Drake & Ruhoff

Genus *Derephysia* Spinola

Derephysia Spinola 1837. Type species: *Tingis foliacea* Fallén.

Derephysia gardneri Drake & Poor 1936. Type: United States National Museum.

Genus *Dictyonota* Curtis

Dictyonota Curtis 1827; Fieber 1844; Walker 1873a. Type species: *Dictyonota strichnocera* Fieber.

Dictyonota pakistana Drake & Maldonado 1959. Type: United States National Museum.

Dictyonota pusana Drake & Maa 1955. Type: British Museum.

Genus *Dictyotingis* Drake

Dictyotingis Drake 1942a. Type species: *Dictyotingis gibberis* Drake.

Dictyotingis gibberis Drake 1942a. Type: United States National Museum.

Dictyotingis monticula Drake 1956b. Type: United States National Museum.

Note: The following taxa have been wrongly classified as Tingidae.

1. *Cymus basicornis* Distant 1903b. = Lygaeidae
2. Phyllogasterotinginae Menon & Hakk 1959a (*nom. nud.*); Menon, Beri & Singh 1959. = Coreidae
3. *Phyllogasterotingis acheranthi* Menon & Hakk 1959a (gen. sp.; *nom. nud.*); Menon, Beri & Singh 1959. = Coreidae

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Ectoparasites of bats from Nepal[1,2]

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The ectoparasites collected from eleven species of Nepal bats are discussed. These records constitute the most comprehensive data presently available on the external parasites of Nepal Chiroptera. The ectoparasites consisted of nycteribiid flies (*Cyclopodia sykesii, Nycteribosca proxima, N. modesta*), argasid ticks (*Ornithodoros coniceps, Reticulinasus* sp., *Argas reflexus. A. vespertilionis, laelapid* (*Neolaelaps spinosa*) and spinturnicid (*Spinturnix plecotinus*) mites and several ischnopsyllid fleas (*Thaumapsylla breviceps, T. indicus, Mitchella exsula*).

Introduction

Very little information is available on the ectoparasites of the bats of Nepal. Ectoparasite records of Chiroptera from adjacent areas have been provided by Hoogstraal (1957), Kohls (1957), Hoogstraal & Kaiser (1968) and Kaiser & Hoogstraal (1974). The Indian Subregion including the Himalayas contains a varied endemic vertebrate and ectoparasite fauna that merits detailed analysis. General investigations on the external parasites of mammals excluding bats are available in the literature (Anastos 1950; Dhanda & Rao 1964; Emerson 1971; Hoogstraal 1970; Sharif 1928; Trapido & Hoogstraal 1964). Specific information concerning ectoparasites of Nepal bats is provided by Worth & Shah (1969) who list parasitic diptera and fleas from the fruit bat, *Rousettus leschenaulti*, laelapid mites from *Miniopterus schreibersi* and *Pteropus giganteus*, the flea *Ischnopsyllus indicus* identified from bats collected near Kathmandu and by Lewis (1970) who described the flea *Mitchella exsula* from the pipistrelle bat, *Pipistrellus babu*. The purpose of this paper is to provide a current comprehensive list of the ectoparasites of Nepal bats. A detailed discussion of the geographical districts of Nepal is given by Karan (1960).

Equipment and Method of study

The bats were collected by the senior author in Nepal between 1967 and 1970. The majority of specimens were collected with mist and insect nets, and several were shot. Each captured animal was immediately placed in a cloth bag and stored in a sealed metal container provided with a small quantity of chloroform to immobilize the ectoparasites. Later, each specimen was rubbed with a toothbrush over a white pan with special attention being focused around the eyes and ears for ticks, the belly fur for fleas and the urogenital region for mites.

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TABLE 1

ECTOPARASITES COLLECTED FROM NEPAL BATS
(1967 TO 1970)

Host Species	Collection Locality	Number Collected	Number Parasitized	Ectoparasite Species
Pteropodidae				
Cynopterus sphinx	Sankhuwasabha	3	3	*Thaumapsylla breviceps* (Siphonaptera: Ischnopsyllidae)
		3	3	*Nycteribosca modesta* (Diptera: Streblidae)
Pteropus giganteus	Kathmandu	20	17	*Neolaelaps spinosa* (Acari: Laelapidae)
			15	*Cyclopodia sykesii* (Diptera: Nycteribiidae)
Rousettus leschenaulti	Kathmandu	6	6	*Ornithodoros coniceps* (Acari: Argasidae)
			3	*Reticulinasus* sp. (Acari: Argasidae)
			6	*Thaumapsylla breviceps* (Siphonaptera: Ischnopsyllidae)
			2	*Cyclopodia sykesii* (Diptera: Nycteridiidae)
Rhinolophidae				
Rhinolophus ferrumequinum	Kathmandu	2	2	*Cyclopodia sykesii* (Diptera: Nycteribiidae)
R. lepidus	Sindu	6	6	*Spinturnix plecotinus* (Acari: Spinturnicidae)
			5	*Cyclopodia sykesii* (Diptera: Nycteribiidae)
			3	*Nycteribosca proxima* (Diptera: Streblidae)
Vespertilionidae				
Barbestella leucomelas	Sindu	1	1	*Spinturnix plecotinus* (Acari: Spinturnicidae)
Eptesicus sp.	Sankhuwasabha	1	1	*Argas* sp. (Acari: Argasidae)
Myotis mysticinus	Kathmandu	1	1	*Cyclopodia sykesii* (Diptera: Nycteribiidae)
Nyctalus leisleri	Dang-Deokhuri	1	1	*Argas vespertilionis* (Acari: Argasidae)
Pipistrellus babu	Sindu	7	6	*Spinturnix* sp. (Acari: Spinturnicidae)
			6	*Ischnopsyllus indicus* (Siphonaptera: Ischnopsyllidae)
			1	*Mitchella exsula* (Siphonaptera: Ischnopsyllidae)
Scotophilus heathi	Banke	5	5	*Argas vespertilionis* (Acari: Argasidae)

Each cloth bag was also carefully examined for ectoparasites. The ectoparasites were placed in vials containing 70 per cent alcohol.

Data on each host included the Nepal Project Number (NP), locality (Karan 1960), date, sex, field notes and ectoparasites. Ectoparasite determinations were performed by Dr. H. Hoogstraal (Acarina: Ixodoidea), director of the Medical Zoology Section, Naval Medical Research Unit, Cairo, Egypt, UAR; Dr. R. E. Lewis (Siphonaptera), Department of Entomology, Iowa State University, Ames, Iowa, USA; Dr. R. W. Strandtman (Acari) of the Bishop Museum, Hawaii; and Dr. R. Wenzel (Acari) of the Chicago Field Museum of Natural History, Chicago, Illinois, USA.

Results and Discussion

The ectoparasites collected from 11 species of Nepal bats are listed in Table 1. These external parasites consisted of nycteribiid flies (*C. sykesii, N. proxima, N. modesta*), argasid ticks (*O. coniceps, Reticulinasus* sp., *A. reflexus, A. vespertilionus*), laelapid (*N. spinosa*) and spinturnicid (*S. plecotinus*), mites and several ischnopsyllid fleas (*T. breviceps, T. indicus, M. exsula*).

Previous investigations of bat flies (Diptera) have shown these ectoparasites to be representatives of the Nyteribiidae and Streblidae. The streblid, *Nycteribosca proxima,* was identified from only one species of bat (*R. lepidus*) in the present study. Bat flies of the family Nycteribiidae were identified from five species of Nepal bats (Table 1). All nycteribiids collected were identified as *Cyclopodia sykesii. C. sykesii* has been previously reported from *Pteropus giganteus, P. intermedius* and *Scotophilus kuhli* from the Oriental Region by Scott (1925).

Argasid ticks are obligate temporary parasites of vertebrates which prefer relatively open terrain where they frequent enclosed habitats such as caves, rock crevices and burrows (Balashov 1972). In this study, argasid ticks were identified on four species of Nepal bats collected from the districts of Kathmandu, Sankhuwasabha, Dang-Deokhuri and Banke (Karan 1960), all of which are characterized by terrain very similar to that described above as the preferred habitat of these ticks.

The laelapid mite, *Neolaelaps spinosa,* has been previously recorded from several Indian specimens of *Pteropus giganteus* by Radovsky (1967). Seventeen of twenty specimens of *P. giganteus* from Kathmandu were also found to be parasitized by this mite. *N. spinosa* has also been recorded from bats of Ceylon, Java, Australia and New Caledonia (Rodovsky 1967).

Spinturnicid mites have been found to be exclusively parasitic on bats throughout their life cycle. A detailed discussion of the spinturnicids is given by Rudnick (1960). The spinturnicid mite identified from 3 species of Nepal bats in this study was *Spinturnix plecotinus.* This species has been previously recorded only from vespertilionid bats of the genus *Plecotus* (Rudnick 1960). The identification of *S. plecotinus* from specimens of *Rhinolophus lepidus* (Rhinolophidae), *Barbestella leucomelas* (Vespertilionidae) and *Pipistrellus babu* (Vespertilionidae) represents the first records of this mite from these bats.

Several ischnopsyllid fleas were also identified from bat specimens. *Thaumapsylla breviceps* was identified from two species of bats (Table 1). *Ischnopsyllus indicus* and *Mitchella exsula* were identified from the host *Pipistrellus babu.*

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Responses of certain fishes and snakes to sound[1]

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(*With three figures in a plate*)

Very little work has been done on the hearing capacity or mechanism of the lower vertebrates in India. Earlier workers like Kreidl (1895) believed that fishes were deaf or, at best, could receive some vibrations through cutaneous sense. Only after Bigelow (1904) and others, was it proved conclusively that fishes do perceive sound.

In fishes, in addition to the inner ear, the lateral line system perceives both the displacement of the medium and near field sounds of low frequency range (Harris & Van Bergejik 1962; Tavolga 1971). It is thus obvious that the hearing mechanisms in lower vertebrates differ vastly from those of man and other mammals, and a comparison of the different hearing mechanisms could be of special interest. While it is known that some of the lower vertebrates have the capacity to hear air conducted sounds, it is said that snakes perceive sounds by bone conduction (Tumarkin 1968). Eventhough there are some inconclusive reports and concepts on the hearing capacity of ophidians, scientifically proven studies are wanting as obvious from the review of hearing mechanisms in vertebrates by DeReuck & Knight (1968). Hence, in this study, an attempt is made to evaluate the hearing capacity of a few fishes and snakes of South India.

Materials and methods

Four species of teleost fishes namely *Rhinomugil corsula* (Mullet), *Tilapia mossambica* (Tilapia), *Anabas scandans* (Indian Climbing Perch) and *Cyprinus carpio* (Common Carp) and the following snakes: *Ptyas mucosus* (Rat Snake), *Argyrogena fasciolatus* (Banded Racer), *Boiga ceylonensis* (Ceylon Cat Snake), *Eryx johni* (Sand Boa) and *Ahaetulla nasutus* (Green Whip Snake) were used for this study. Of these snakes, *Boiga ceylonensis* and *Ahaetulla nasutus* are mildly poisonous snakes (Rajendran 1968; Smith, Malcolm A. 1942).

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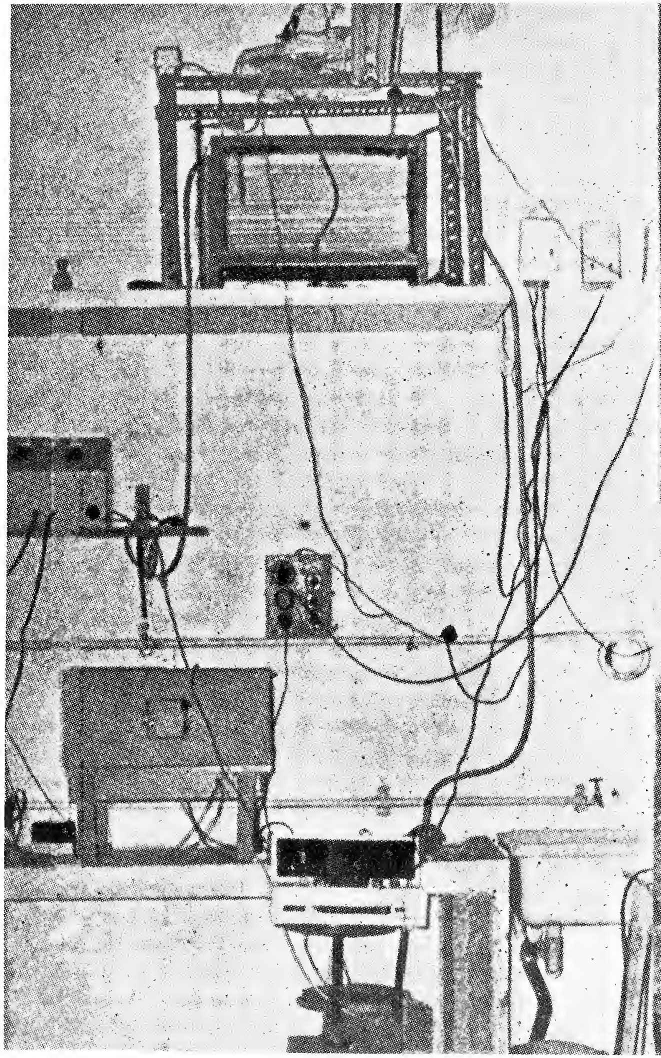

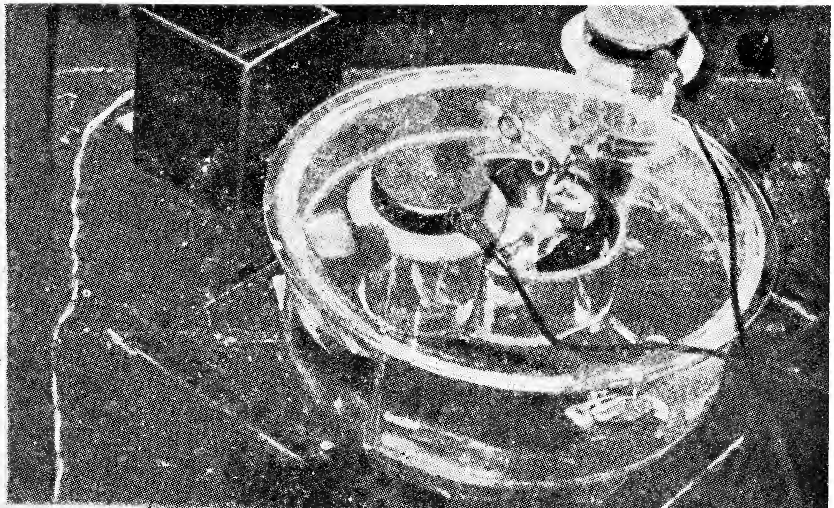

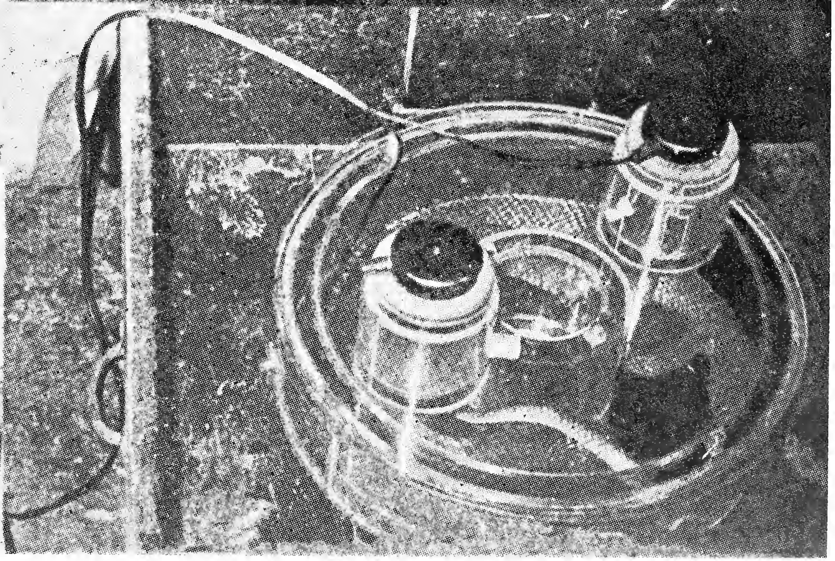

Left—Fig. 1. General experimental set-up showing the activity chamber, electronic counter, the water recirculation system (for fishes) and audiometer. *Right above*—Fig. 2. Annular activity chamber showing experimental fish (*Tilapia mossambica*) inside and the connecting ear phones from the audiometer. *Right below*—Fig. 3. Activity Chamber with the snake (*Ptyas mucosus*) inside.

An audiometer (Manufacturers: Bharat Electronics Limited, Bangalore) with pure tone and speech audiometry was used for this study along with an activity chamber modified by Kutty *et al.* (1971) connected to an electronic counter (Fig. 1).

The experimental animal was left inside the transparent plastic annular activity chamber and the two ear phones of the audiometer with rubber pads were snugly fitted to the two top wells of the chamber. This unit was kept inside a wooden box to shut off external light and disturbance. A peep hole covered with a one way plastic viewer, was used for observing the animal. The inside of the box was lighted from above. There was provision for measuring the random activity of the animal when it moved round the chamber. This was facilitated by focussing two beams of light (directed from outside of the chamber) on two photocells fixed in the inner hollow of the annular activity chamber. When the animal moved and cut the beam of light the event was counted and a record of the activity per unit time was made.

In the case of fishes the activity chamber was filled with water leaving an air column at the top of the wells (Fig. 2) and there was provision to flush the chamber with fresh water continuously by means of a circulatory system. As for snakes, the animals were left in the chamber as such and their activity observed (Fig. 3). In addition to random locomotary activity of the animal, other behavioural changes were also observed and recorded.

Results and Discussion

Fishes

All the four species of fishes tested responded to pure tones. Different behavioural changes were observed in the four species. Behavioural changes taken as responses to sound were changes in locomotor activity and eyeball movements. Locomotor activity and eyeball movements were counted respectively by the Electronic Counter and visually in an undisturbed condition (control). Various frequencies of sound were fed to the annular chamber through the ear phones and the intensity of the sound was increased stepwise every 10 dbs and changes counted and analysed. In the case of Mullet, its random locomotor activity increased when subjected to the sound as could be seen from the data given in Table 1.

TABLE 1

RESPONSES (CHANGES IN LOCOMOTOR ACTIVITY) TO SOUND IN *Rhinomugil corsula*

Mean weight: 35.5 gm — Water Temp.: 25°C
Mean length: 16.5 cm — Room Temp.: 27°C

Frequency c/s.	10 dB.	20 dB.	30 dB.	40 dB.	50 dB. and above
125	—	+	+	+	+
250	—	+	+	+	+
500	—	+	+	+	+
1000	—	+	+	+	+
1500	—	—	+	+	+
2000 and above.	—	—	—	—	—

+ Increase in Locomotor activity from control. — No increase from control.

As can be seen from the Table, Mullet, which is a non-ostariophysid in which Weberian ossicles are absent can perceive frequencies upto a maximum of 1,500 cycles/second only and the hearing threshold was found to be about 20 dB. The lateral line system helps in perceiving only low frequency tones. This finding is in conformity with that of Maliukina (1960).

Anabas scandans and *Tilapia mossambica*, the two other species of fishes did not show any significant change in locomotor activity and hence other behavioural changes like movement of the eye balls were studied in both these species. The rate of movement of the eye balls was found to be lesser when they were subjected to pure tones of various frequencies. Hearing response in *Anabas scandans* is shown in Table 2.

connected with the internal ear by means of a chain of ossicles known as Weberian ossicles, perceive high frequency sound (Enger 1968; Tavolga 1971). The fish *Anabas scandans* has an accessory respiratory organ known as the labrynthiform organ—an air pocket in the head, which functions similar to the swim bladder of the ostariophysids, aiding in auditory functions. The sound converted as pressure wave touching the fish is amplified by the swim bladder or any other air pocket in the fish. In spite of this the non-ostariophysids are also able to perceive sound frequencies though at a lower level. Behavioural study in response to pure tone transmission in *Tilapia mossambica*, further confirmed that the hearing in non-ostariophysids is limited to the low frequencies as shown in Table 3.

Hearing responses of a typical ostariophysid,

TABLE 2

RESPONSES (CHANGES IN RATE OF EYEBALL MOVEMENTS) TO SOUND IN *Anabas scandans*

Mean Weight: 26.5 gm — Water Temp.: 25°C
Mean length: 10.5 cm — Room Temp.: 27°C

Frequency c/s.	10 dB.	20 dB.	30 dB.	40 dB.	50 dB. and above
125	—	+	+	+	+
250	—	+	+	+	+
500	—	+	+	+	+
1000	—	+	+	+	+
1500	—	+	+	+	+
2000	—	—	+	+	+
3000	—	—	+	+	+
4000	—	—	+	+	+
6000 and above	—	—	—	—	—

+ Decrease in Eyeball movements from control. — No decrease from control.

From above it is obvious that as regards frequency discrimination *Anabas scandans* can hear frequencies upto 3,000 c/s, threshold of intensity for the various frequencies being 20 to 30 dB. This is similar to the observation that ostariophysids which have a swim bladder the common carp *Cyprinus carpio* is shown in Table 4.

It can be seen that these fish responded very well upto frequencies of 4000 c/s the highest range of hearing capacity among all fishes studied.

TABLE 3

RESPONSES (CHANGES IN RATE OF EYEBALL MOVEMENTS) TO SOUND IN *Tilapia mossambica*

Mean Weight: 30 gm — Water Temp: 25°C
Mean Length: 12 cm — Room Temp: 27°C

Frequency c/s.	10 dB.	20 dB.	30 dB.	40 dB.	50 dB. and above
125	—	+	+	+	+
250	—	+	+	+	+
500	—	+	+	+	+
1000	—	+	+	+	+
1500 and above	—	—	—	—	—

+ Decrease in Eyeball movements from control. — No decrease from control.

TABLE 4

RESPONSES (CHANGES IN RATE OF EYEBALL MOVEMENTS) TO SOUND IN *Cyprinus carpio*

Mean Weight: 37 gm — Water Temp: 25°C
Mean Length: 18 cm — Room Temp: 27°C

Frequency c/s.	10 dB.	20 dB.	30 dB.	40 dB.	50 dB. and above
125	—	+	+	+	+
250	—	+	+	+	+
500	—	+	+	+	+
1000	—	+	+	+	+
1500	—	+	+	+	+
2000	—	—	+	+	+
3000	—	—	—	+	+
4000	—	—	—	—	+
6000 and above	—	—	—	—	—

+ Decrease in Eyeball movements from control. — No decrease from control.

A study of the 4 species of fishes confirmed the view that ostariophysids have a better hearing range than the non-ostariophysids. But the threshold of hearing was about the same (20 to 30 dB) in both ostariophysids and non-ostariophysids. It appears that the ostariophysids possess the lowest auditory thresholds and highest upper frequency limits. This is undoubtedly a function of the Weberian apparatus which couples the auditory signal received by the swim bladder to the inner ear in a manner analogous to the operation of the middle ear ossicles in man. Other air chambers can serve a similar fashion as the branchial cavity in the labyrinthine fishes (Schneider 1941) and as shown in the case of *Anabas scandans.*

Snakes

None of the snakes responded to pure tones. However, all of them responded to music both instrumental and drum, fed to the activity chamber through an audiometer at 50 and 100 dB intensities. The results are shown in Table 5.

Ptyas muscosus (Rat Snake) when exposed to the music of predominant low frequency tones at 100 dB, the visible normal respiratory

TABLE 5

RESPONSES TO SOUND IN SNAKES (Room Temp.: 27°C)

Species	Pure Tone	50 dB.	Music	100 dB.
Ptyas mucosus	0	+		+++
Ptyas mucosus	0	+		+++
Argyrogena fasciolatus	0	+++		+++
Boiga ceylonensis	0	++		++
Eryx johni	0	0		0
Ahaetulla nasutus	0	0		0

0 = No response. + = Mild response. ++ = Fair response. +++ = Good response.

movements suddenly stopped and was followed by hurried respiration indicating fright. For the same music at 50 dB the response was only mild.

Argyrogena fasciolatus (Banded Racer) when screened responded markedly to music by moving its head from side to side. Its response was good both at 50 and 100 dB.

Boiga ceylonensis (Ceylon Cat Snake) exhibited continuous movements normally as also when pure tones were fed, but responded well to music by abrupt cessation of movements.

Eryx johni (Sand Boa) and *Ahaetulla nasutus* (Green Whip Snake) the other two snakes also tested in this study, did not show any definite response at all, to either pure tones or the music. *Eryx* was highly inactive and indifferent and *Ahaetulla* though active, did not respond to sound appreciably.

In all these cases, the reaction seemed to be one of fright.

Previous work on the endolymph and allied fluids of fish and mammalia (Kameswaran *et al.* 1972) and the effect of labyrinthine disturbance on metabolism and activity in certain vertebrates (Kameswaran *et al.* 1974) has shown that the inner ear as such is primitive in fishes and less markedly developed in reptiles; hence the limitations of hearing capacity in these animals.

SUMMARY

Study on responses to sound was carried out on selected fishes and a few snakes.

It was found that in fishes the highest frequency range upto 4000 cycles/second was perceived by *Cyprinus carpio*, an ostariophysid. The *Anabas scandans* which has an accessory respiratory organ known as labyrinthiform organ which functions similar to the swim bladder ostariophysids enables it to hear upto 3000 cycles/sec. The other two, non-ostariophysids, *Rhinomugil corsula* and *Tilapia mossambica*, the highest frequency range was found to be 1500 and 1000 cycles/second, respectively.

There was no significant variation in hearing thresholds between the ostariophysids and non-ostariophysids, which was about 20 to 30 dB.

It is interesting to note that snakes did not respond to pure tone irrespective of the frequency or intensity, whereas they responded only to music (mixed tones) which was of predominant low frequency and that the response was chiefly one of fright.

Of the snakes, studied, *Ptyas mucosus, Argyrogena fasciolatus* and *Boiga ceylonensis* exhibited very good response to sounds, whereas *Eryx johni* and *Ahaetulla nasutus,* showed no definite response.

The results of this study confirm that the fishes and snakes have a much limited hearing range when compared to man.

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On the occurrence of *Arenicola bombayensis* Kewalramani et al. (Family Arenicolidae, Polychaeta) at Muttam in south-west India[1]

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(*With three text-figures*)

INTRODUCTION

The records of the occurrence of the genus *Arenicola* on Indian coasts are few. Two species have been recorded from the coasts of India. Ranade (1952) reported the occurrence of the genus *Arenicola* on the Bombay coast. It was later identified as a new species, *Arenicola bombayensis,* by Kewalramani *et al.* (1959). Tampi & Rangarajan (1963) recorded *Arenicola brasiliensis* Nonato from Laccadive Islands and Gaikwad (1971) from Ratnagiri. Apart from these three records the genus has not been known so far from any other part of India.

HABITAT

During a tour in late December 1970 to Muttam coast, cylindrical castings, resembling those of lugworms, were observed in a shallow intertidal rock pool. Muttam is located (8°10′ N., 77°11′ E.) about 24 km north of Cape Comorin on the south-west coast of India. Two large specimens of *Arenicola* were dug out from the burrows, from about 40 cm below the surface of the mud. The burrows were unlined. The lugworms were found head downwards in their burrows.

The mud in the pool was extremely soft and black in colour, giving the smell of iodoform. There was no vegetation and the water was very clear. Several specimens of Hemichordates were also collected from the same pool along with *Arenicola.* Tampi & Rangarajan (1963) also reported the presence of Hemichordates with *Arenicola brasiliensis.*

The two lugworms were preserved in 5 per cent formalin and were later identified as *Arenicola bombayensis* Kewalramani *et al.* A brief description of the forms is given below.

Arenicola bombayensis Kewalramani *et al.* 1959.

Measurements in mm:

Length excluding tail	tail*
126	30
89	24

Colour pale brown in life, reddish brown in preservative. Body anteriorly thick; tail region relatively short and narrow; head without tentacles and palps; eyes tiny, indistinguishable externally; prostomium small and trilobed. Peristomium and the succeeding seg-

[1] Accepted August 1974.

* Broken in both forms.

ment without parapodia and setae; each segment of two annuli. First annulus of peristomium subdivided into two. First three setigerous segments with two, three, and four annuli respectively; the remaining segments with five annuli per segment. Annulation of the tail region, variable. The number of annuli per segment increases from the anterior region backwards. The tail region of the worm, measuring 126 mm in length, contains eleven segments, each having 5, 5, 5, 9, 9, 10, 9, 10, 11, 12, and 12 annuli respectively. The worm measuring 89 mm contains eight segments in the tail region, which have 5, 5, 5, 5, 5 9, 9, and 20 annuli respectively.

A portion of proboscis is everted through the mouth. This is provided with several rows of short, curved, conical papillae.

There are 17 setigers in segments 2 to 18. In each segment a pair of parapodia is based on the penultimate annulus which is slightly wider. The parapodia have neither acicula nor cirri. The notopodium bears elongated unjointed setae which project from a setal sac. The notopodial setae are very sharply pointed; their distal ends are toothed (fig. 1). They are golden yellow in colour and are arranged in two rows. The maximum length of the notopodial seta is 580 microns, of which 180 microns of the distal end is exposed outside the setal sac. It has a thickness of 70 microns in diameter.

The neuropodia are ventro-laterally located and comprise of dorso-ventrally elongated muscular ridges. Each neuropodium has one such ridge from which the tips of double rows of sigmoid setae project. The neuropodial seta (crotchet) (fig. 2) is 280 microns in length and 10 microns thick. The post-rostral region of crotchets is not dilated. The neuropodia are extended from notopodia to almost the mid-ventral line. They are not conspicuous in the first three setigerous segments.

Eleven pairs of elegantly pinnate gills with 12-18 main stems are associated with the parapodia in setigerous segments 7 to 17 (inclusive). They were red in colour, when alive, because of blood. Ventral stems are very small. A slight variation in the number of main stems in the gills was noticed on the right and left

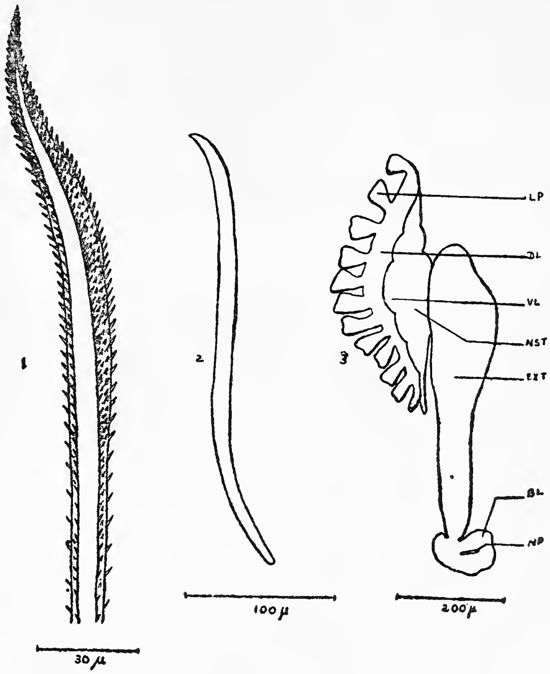

Fig. 1. Tip of a notopodial seta.
Fig. 2. Neuropodial seta (Crotchet).
Fig. 3. Nephridium. LP—leaf-like process of nephrostome, DL—dorsal lip of nephrostome, VL—ventral lip of nephrostome, NST—nephrostome, EXT—excretory tube, BL—bladder and NP—nephridiopore.

sides. The number of branches in each stem ranges from 12 to 25 and they are arranged alternately. The main stems of a gill radiate out finger-like from the basal web.

The segments of the tail region lack parapodia, but small epidermal papillae occur on the tail. They are segmentally arranged. There

are 4 such papillae per segment—one dorsal, two laterals and one ventral in position, and all project backwards, Gamble & Ashworth (1900) observed similar type of papillae in *A. cristata*. Each papilla is 90 microns in length, having a thickness of 30 microns in diameter at the base and 15 microns at the distal end. The papillae are found on the penultimate annulus when there are 5 annuli in a segment, but are observed on the third annulus, when the segment consists of more than 5 annuli.

There are seven pairs of yellow nephridia (fig. 3) opening on setigers five to eleven. All the nephridia in the worm measuring 126 mm are uniform in size. The 6th nephridium of the left side on the 10th setigerous segment was removed and a permanent mount was made. The length of the nephridium is 780 microns and width 240 microns. It has a large nephrostome 480 μ in length with extremely prominent, branched leaf-like processes on the dorsal lip. The nephridiopores, which are not hooded, are located just above and behind the neuropodia.

Both are females. In the smaller worm the body cavity was completely filled with masses of developing eggs, which are discoidal in shape and 70-160 microns in diameter. The eggs numbered about 3.5 lakhs of which 10 per cent range from 70 to 90 microns, 85 per cent of eggs from 90 to 110 microns, and 5 per cent of eggs from 110 to 160 microns in diameter. The ovaries are not conspicuous.

The larger worm's coelomic cavity contained very few eggs. The nephridia were considerably enlarged and the excretory tube and bladder were distended and highly folded. These two observations, of one worm with numerous developing eggs and the second with very few eggs and highly distended nephridia, show that the breeding season of *A. bombayensis* at Muttam, to be in December. Gaikwad (loc. cit.) found eggs of *A. brasiliensis* at Ratnagiri in April.

The position of the ventral nerve cord in relation to muscle layers is of considerable importance in arenicolid taxonomy. A transverse section of the ventral body wall of one of the branchiate segments was made and examined under a binocular dissecting microscope. This showed that the longitudinal muscle layer is interrupted, so that there is no longitudinal muscle layer between the nerve cord and the circular muscle layer. A small gap is also noticed between the nerve cord and the circular muscle layer.

The first septum bears a pair of backwardly projecting septal pouches. At the hinder end of the oesophagus there is a single pair of oesophageal glands.

Remarks

The lugworms of the tropical and subtropical beaches of the world have been referred to five species (Wells 1962): *R. cristata* Stimpson 1856, *A. caroledna* Wells 1961, *A. glasselli* Berkeley 1939, *A. bombayensis* Kewalramani *et al.* 1959, and *A. loveni* Kinbery 1866. *A. bombayensis* resembles *A. cristata* and *A. brasiliensis* (= *A. caroledna* Wells 1961) in having 17 setigers and 11 pairs of gills and *A. glasselli* in having 7 pairs of nephridia opening on setigers V to XI. The position of the "dorsal septal change" between septal planes X and XI confirms the close relation of *A. bombayensis* to *A. cristata, A. brasiliensis* and *A. glasselli*. *A. bombayensis* differs from *A. cristata* in having no longitudinal muscle outside the nerve cord. Examination of the nephridiopores reveals, however, an important distinction that those of *A. bombayensis* are plain, while those of *A. brasiliensis* and *A. glasselli*

are fully hooded (Wells 1962).

A. bombayensis can be distinguished from other species based on a number of important anatomical characters such as 17 setigers, 11 pairs of gills highly pinnate with basal web, 7 pair of nephridia, naked nephridiopores, very frilly nephrostomes, no longitudinal muscle between nerve cord and circular muscle layer and shortness of tail with segmentally arranged dermal papillae.

A lugworm collected by Ashworth (1911) from Barrow Island in North-west Australia has been identified as *A. bombayensis* by Wells (1962). *A. bombayensis* has so far been recorded from Barrow Island in North-west Australia and from Bombay in India. Apart from these two records, this species has not been known to occur in any other part of the world. The present record of this species extends its range of distribution to the Muttam coast (near Cape Comorin) on the south-west coast of India.

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Authors' catalogue of the botanical articles published in the Journal of the Bombay Natural History Society (Vol. 1-66, 1886-1969)[1]

Compiled by
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Introduction

This paper brings together all the botanical articles that have appeared so far in this *Journal* from its very first volume till 1969. It would be useful to any person interested in Indian Botany. Attempt has been made here to present them in a very simple form as an aid to research workers. With a view to keep this lengthy catalogue within a moderate size only one main entry has been given for each article. Although no pain has been spared to maintain bibliographical accuracy, I shall be grateful to readers for detection of omissions and lapses. I am grateful to Miss D. Kanhere for her help in compilation of this catalogue.

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The ground activity of spiders (Araneae) and harvestmen (Phalangidae) in West Bengal, India[1]

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(*With eight text-figures*)

Spiders and harvestmen were collected from August 1971 through August 1972 with pit-fall traps set once each week in four different habitats: a tree-shrub site, a bamboo grove, a banana grove, and a grassy plot. During the first eleven months of the study 901 spiders representing 19 species and 11 families were collected, 36 per cent of which occurred on the grassy plot. The family Lycosidae accounted for 93 per cent of the spiders collected and was primarily represented by two species: *Lycosa birmanica* and *L. sumatrana*. The former species was most active on the grassy plot and in the tree-shrub site during the premonsoon-monsoon months, and the latter was most active on the grassy plot during the monsoon-postmonsoon months. Females of these two species, and of *L. tista* and *Drassodes oppenheimeri* were more active than the males. Harvestmen were most active on the ground in the tree-shrub site, particularly in March; a total of forty was caught. The low number of species caught in this study, as compared to temperate zone studies, is probably due in part to trapping procedure and to habitat disturbance brought about by the activities of man and his domesticated animals. New species distribution records are noted.

Introduction

Spiders and harvestmen, along with carabid beetles, are extremely important predators of the ground dwelling micro-fauna (Williams 1962). Their diet is known to consist of those organisms that are abundant, slow moving or inactive, and soft of body, such as smaller spiders, beetles, homopterans, hymenoptera and flies (Breymeyer 1967; Goodnight 1961). Flies are a very important part of the diet of lycosid spiders, at least at certain times of the year (Edgar 1969, 1971a). This takes on added significance when the role of flies in the transmission of bacteria, viruses, and parasites pathogenic to man and his domesticated animals, particularly in the tropics, is taken into consideration (Graham-Smith 1913; Pipkin 1949; Roberts 1934).

A large number of studies have been done on the seasonal activity of spiders and harvestmen on the ground in temperate regions, pri-

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marily in Europe (Edgar 1971a; Russell-Smith & Swann 1972; Williams 1962), but such knowledge is lacking for the tropical regions. Probably one of the main reasons for this is that the taxonomy of spiders and harvestmen in temperate regions is relatively well known, whereas in tropical regions it is in many cases still being worked out. The opportunity to gain such information in a tropical area arose during the course of a study of dung beetle ecology by one of us (J.R.O.), which will be reported on later. The data presented in this paper are based on the collection of spiders and harvestmen obtained over a thirteen month period from ground level pit-fall traps.

Methods

Spiders were trapped weekly from 14 August 1971 to 1 September 1972. During the first six months, up to the end of February 1972, traps were set once each week in each of two villages: Nasibpur and Burasanti. Thereafter, traps were set once a week in only one village: Burasanti. Each village contained four trap-site habitats: a tree-shrub site, a bamboo grove, a banana grove, and a grassy plot. Trapping on the grassy plot was terminated at the end of June 1972, two months prior to the end of the study. Eight pit-fall traps in two parallel rows of four were set at each trap-site. Thus initially each village had a total of thirty-two traps.

The traps were set out between 1500 and 1600 hrs in the afternoon and were picked up the following morning between 0900 and 1000 hrs. This timing of the trap period was related to the activity cycle of scarabid dung beetles and not to the activity of spiders. The traps (23.5 cm in diameter) were sunk in the ground so that the upper rim was flush with the soil surface. A cup filled with sand was placed in the centre of the trap so that a circular band about 2.5 cm wide served as the entrance to the trap. In some traps fecal material was placed on top of the sand in the cup to serve as bait. All the spiders and phalangids caught were found inside the trap, not in the cup. There was no significant difference in the number of spiders caught in the different baited traps, nor between baited and unbaited traps. After removal from the traps, the specimens were sorted, counted and then preserved in alcohol until they could be identified. Phalangids were identified as such, but spiders were identified to species and sex when possible. All specimens are now part of the collection of the Zoological Survey of India.

The species diversity within and across habitats and seasons, and the habitat niche breadth were calculated using Shannon's information theory measure [$H \approx 3.321928/N\ (N\log_{10}N - \Sigma\, n_i\log_{10}n_i)$] and the table for nlogn values in Lloyd *et al.* (1968).

As will be made clear in the discussion, the number of spiders caught in pit-fall traps is indicative of spider activity on the ground and not of spider abundance. Therefore, in the Results section, the data will be presented in terms of activity on the ground.

Study Area

The two villages were approximately five kilometres apart and were 40 km NNW of Calcutta, in the state of West Bengal, India. The villages were densely settled, with some areas within the villages devoted to household gardens, bamboo groves, banana groves, and grassy areas, which occasionally were used to grow crops or as playgrounds. The areas outside of the village limits were devoted to raising of jute, rice, and some wheat and vegetables.

The four trap-sites in each village were chosen to represent the four more important vegetation types in the villages, as mentioned above. The tree-shrub sites were mango groves, which had a few palm trees, as well as some other tree species, interspersed. The branches and leaves of these trees formed a thick closed canopy throughout the year. A dense shrub layer, about one metre high, covered the ground, except in the area immediately around the traps. The bamboo groves had clumps of bamboo plants scattered within them, but the trunks of the plants arched over the open areas within the groves so that a thin, but almost closed canopy was formed. The ground surface in the open areas was covered with a thin layer of dead bamboo leaves except in the area immediately around the traps, which was bare. The banana groves had banana plants spaced 3 to 4 metres apart. The leaves of the banana plants formed an open canopy, and each day all the soil surface within the groves received direct sunlight. The soil surface was bare. The grassy plots had a layer of grass throughout the year, which was kept short due to grazing by cattle and goats. Canopy plants and canopy were lacking. During the monsoon months, some inedible weeds grew up to about 30 cm in height and provided an open "shrub-type" layer on the Burasanti grassy plot. These weeds died back fairly quickly at the beginning of the dry season. Diurnal soil surface temperatures were highest in the banana grove and grassy plot, and lowest in the bamboo grove and tree-shrub site.

The pit-fall traps were placed in the centre of the trap-site habitats when possible. The area of the habitats was variable, ranging from 450m^2 to 4275m^2, with those in Nasibpur larger than those in Burasanti. Since the areas of the trap-site habitats were variable, and in some the trap locations were off-centre, a better measure is to quantify the habitat heterogeneity within given distances from the trap locations. All trap-sites were homogenous for habitat type within a circle of 4 m radius (50m^2) from the centre of the trap location. All trap-sites were heterogeneous for habitat type within a circle of 20 m radius (1252m^2) from the centre of the trap location. The "bamboo"

Table 1

Degree of heterogeneity of trap-site habitats—Per cent of area covered with different types of vegetation or devoted to other types of land use within a circle of 20 m radius centred at the trap location

	Burasanti				Nasibpur			
	Tree-shrub	Bamboo	Banana	Grass	Tree-shrub	Bamboo	Banana	Grass
Shrub	16	16	22	8	25	—	11	27
Tree-shrub	35	—	—	—	33	—	—	—
Bamboo	—	69	—	13	—	88	—	—
Banana	—	—	70	3	30	—	73	8
Grass	—	9	—	43	—	—	—	35
Paths or Cleared	24	—	8	—	7	—	—	—
Houses and Ponds	25	5	—	33	6	12	16	29

and "banana" trap-sites, however, still tended to be representative of their respective habitats, whereas the "tree-shrub" and "grass" trap-sites were less so (Table 1).

The study was started at the height of the monsoon in 1971 and was terminated during the height of the monsoon in 1972 (Fig. 1).

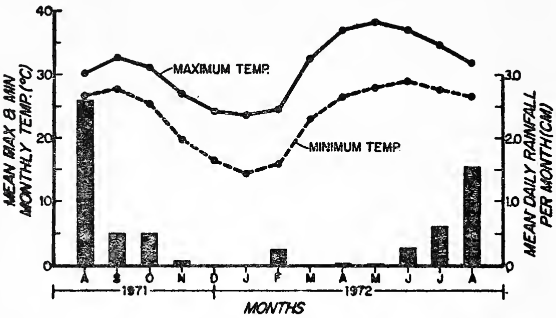

Fig. 1. Mean maximum and minimum daily temperatures per month (°C): ● —— ● maximum, ● —— ● minimum; and mean daily rainfall per month (cm): histograms; in Burasanti village from August 1971 to August 1972.

More rain fell in 1971 than in 1972, and in August 1971 the traps were filled with water and the trap-sites were flooded half the time. Such conditions did not exist during 1972. The total rainfall for Burasanti and Nasibpur from September 1971 through August 1972 was 120 cm and 107 cm respectively. Temperatures were higher in August 1972 than in August 1971, due to the lower frequency of cloud cover.

The ground activity of spiders

Comparison of two villages

During the first seven months of the study, when collections were made in both villages, 550 spiders were obtained. The Nasibpur sites yielded 60 per cent of the spiders, with a mean number of spiders per trap-night of 11.6. This was significantly more than the sites in Burasanti which had a mean of 8.0 spiders per trap-night (df = 6, t = 3.13, $p < .05$). Except for the grassy plot, each of the Nasibpur trap-sites had more spiders than did the similar trap-sites in Burasanti (Table 2).

During this part of the study, 15 species of spiders were collected, 9 in each village (Table 2). Three of these species occurred in both villages (*Lycosa birmanica, L. sumatrana, L. tista*), and they accounted for about 90 per cent of the spiders collected. Since the sample size was small, it was not possible to test whether the distributions of these three species across habitats were the same in both villages. The remaining twelve species occurred in the traps with very low frequency and were, on the average, represented by fewer than three individuals each (range 1 to 10).

The species diversity over the months of September to February for the two villages was similar: Nasibpur—1.79, and Burasanti—1.72 (Table 3).

Hereafter, the data from the first six months from the two villages will be combined.

Comparison of Habitats

Over 900 specimens of 19 different species were obtained during the first 11 months of the study when all four habitats were trapped (Tables 2, 4 and 5). Based on the number of spiders caught, ground activity of spiders was highest on the grassy plot (37%) and lowest in the banana grove (13%). This difference between habitats in relation to spider activity was due to a difference in the number of individuals per species, as there was no significant difference among the habitats in number of species present. The species diversity for the four habitats did vary between villages, and from one season to another, as well as among the habitats, but when all four seasons are taken together, the species diversity in the Burasanti habitats were similar with a range of 1.7 to 1.9 (Table 3). However, in the tree-

TABLE 2

THE NUMBER OF INDIVIDUALS OF EACH SPECIES AND TOTAL NUMBER CAUGHT IN EACH HABITAT PER MONTH

		Month and number of trap days per month (Nasibpur/Burasanti)													Totals			
	Habitat	1971 Aug. 2/2	Sept. 4/4	Oct. 5/5	Nov. *4/4	Dec. *5/5	1972 Jan. 4/4	Feb. 4/4	Mar. 0/5	Apr. 0/4	May 0/4	June 0/5*	July 0/5*	Aug. 0/5*	Aug. 71 - Nasib.*	Feb. 72 Bura.	Aug. - June (Villages combined)	Aug.- Aug.
ARANEAE																		
CTENIZIDAE																		
Acanthodon sp.	BB	—	—	—	—	—	—	—	—	—	—	—	—	1	0	0	0	1
THERAPHOSIDAE																		
Phlogiodes validus	TS	—	—/1	—/2	—	—	—	—	—	—	—	—	—	—	0	3	3	3
OONOPIDAE																		
Diblemma sp.	TS	—	—	—	—	—	—	—	—	—	—	—	—	2	0	0	0	2
	BB	—	—	—	—	—	—	—	—	—	—	—	—	2	0	0	0	2
	BN	—	—	—	—	1/0	—	—	—	—	—	—	—	4	1	0	1	5
	Total	—	—	—	—	1/0	—	—	—	—	—	—	—	8	1	0	1	9
GNAPHOSIDAE																		
Drassodes malodes	BB	—	—	—	—	—	—	—	1	—	—	—	—	—	0	0	1	1
D. oppenheimeri	TS	—	—	—	—	—	—	2/0	—	—	—	3	—	—	2	0	5	5
	BB	—	—	—	1/0	1/0	—	—	—	—	—	1	—	1	2	0	3	4
	BN	—	—	1/0	—	—	—	4/0	1	—	—	—	1	—	5	0	6	7
	G	—	—	—	—	—	1/0	—	1	—	—	21	×	×	1	0	23	×
	Total	—	—	1/0	1/0	1/0	1/0	6/0	2	—	—	25	1	1	10	0	37	16

TABLE 2 (continued)

	Habitat	1971 Aug. 2/2	Sept. 4/4	Oct. 5/5	Nov. *4/4	Dec. *5/5	1972 Jan. 4/4	Feb. 4/4	Mar. 0/5	Apr. 0/4	May 0/4	June 0/5*	July 0/5*	Aug. 0/5*	Totals: Aug. 71 - Feb. 72 Nasib.*	Totals: Bura.	Totals: Aug. - June (Villages combined)	Totals: Aug.- Aug.
Gnaphosa sp.	TS	—	—	—	—	—	—	—	1	—	—	—	—	—	0	0	1	1
THERIDIIDAE																		
Cyllognatha surabjae	BB	—	—	—	2/0	—	—	—	—	—	—	—	—	—	2	0	2	2
Theridion sp.	BN	—	—	1/0	—	—	—	—	—	—	—	—	—	—	1	0	1	1
THOMISIDAE																		
Thomisus cherapunjeus	BB	—	—	—	—	—	—	—	—	1	—	—	—	—	0	0	1	1
	BN	—	—	—	0/1	—	—	—	—	—	—	—	—	—	0	1	1	1
	G	—	—	—	—	—	0/2	—	—	—	—	—	×	×	0	2	2	×
	Total	—	—	—	0/1	—	0/2	—	—	1	—	—	—	—	0	3	4	2
Xysticus minutus	TS	—	—	—	—	—	—	—	—	1	—	—	—	—	0	0	1	1
HETEROPODIIDAE																		
Heteropoda sp.	TS	—	—	1/0	—	—	1/0	—	1	—	—	—	—	—	2	0	3	3
	BN	—	—	—	—	—	—	0/1	2	—	—	—	—	—	0	1	3	3
	Total	—	—	1/0	—	—	1/0	0/1	3	—	—	—	—	—	2	1	6	6
CLUBIONIDAE																		
Castianeira sp.	BB	—	0/2	—	—	—	—	—	—	—	—	—	—	—	0	2	2	2
LYCOSIDAE																		
Adult *Lycosa L. annandalei*	G	—	—	0/3	—	—	—	—	—	—	—	—	×	×	0	3	3	×

TABLE 2 (continued)

	Habitat	1971 Aug. 2/2	Sept. 4/4	Oct. 5/5	Nov. *4/4	Dec. *5/5	1972 Jan. 4/4	Feb. 4/4	Mar. 0/5	Apr. 0/4	May 0/4	June 0/5*	July 0/5*	Aug. 0/5*	Totals: Aug. 71 - Feb. 72 Nasib.*	Totals: Aug. 71 - Feb. 72 Bura.	Totals: Aug. - June (Villages combined)	Totals: Aug.- Aug. (Villages combined)
L. birmanica	TS	—	2/0	—	—	0/1	7/8	—	—	17	10	21	26	34	9	9	66	126
	BB	—	3/0	—	—	2/0	2/0	—	—	—	6	16	15	28	7	0	29	72
	BN	—	3/0	—	0/2	—	—	0/1	1	—	—	13	16	27	3	3	20	63
	G	—	28/0	0/4	6/0	—	—	—	—	—	4	20	×	×	34	4	62	×
	Total	—	36/0	0/4	6/2	2/1	9/8	0/1	1	17	20	70	57	89	53	16	177	261
L. nigrotibialis	TS	—	—	—	—	—	—	—	—	2	—	—	—	—	0	0	2	2
L. sumatrana	TS	1/0	—	7/0	4/0	10/0	11/0	—	—	—	—	—	—	5	33	0	33	38
	BB	0/4	0/2	1/2	1/2	8/0	2/0	—	4	—	—	—	2	3	12	10	26	31
	BN	—	—	1/0	2/0	0/1	—	—	—	—	—	1	—	—	3	1	5	5
	G	7/3	—	12/1	0/8	1/0	6/0	—	—	—	—	3	×	×	26	12	41	×
	Total	8/7	0/2	21/3	7/10	19/1	19/0	—	4	—	—	4	2	8	74	23	105	74
L. tista	TS	—	—	—	—	0/3	—	—	—	—	—	—	—	—	0	3	3	3
	G	—	—	—	—	3/2	1/0	0/9	1	—	—	—	×	×	4	11	16	×
	Total	—	—	—	—	3/5	1/0	0/9	1	—	—	—	—	—	4	14	19	3
Lycosa sp.	TS	—	—	—	—	—	—	—	—	—	—	—	—	1	0	0	0	1
	BB	—	—	—	—	—	—	—	—	1	—	—	—	—	0	0	1	1
	BN	—	—	0/2	—	—	0/4	—	1	—	—	3	—	2	0	6	10	12
	G	—	—	—	—	—	—	—	—	—	—	1	×	×	0	0	1	×
	Total	—	—	0/2	—	—	0/4	—	1	1	—	4	—	3	0	6	12	14

TABLE 2 (continued)

	Habitat	1971 Aug. 2/2	Sept. 4/4	Oct. 5/5	Nov. *4/4	Dec. *5/5	1972 Jan. 4/4	Feb. 4/4	Mar. 0/5	Apr. 0/4	May 0/4	June 0/5*	July 0/5*	Aug. 0/5*	Totals: Aug. 71 - Feb. 72 Nasib.*	Bura.	Aug. - June (Villages combined)	Aug.- Aug.
Juvenile *Lycosa*	TS	3/2	2/0	4/3	11/1	15/18	11/11	15/2	18	12	3	1	—	4	61	37	132	136
	BB	—	1/0	0/1	3/8	10/13	23/11	24/3	28	17	—	1	—	2	61	36	143	145
	BN	—	0/1	3/4	8/2	11/3	11/4	4/4	1	8	3	2	—	7	37	18	69	76
	G	—	3/8	1/4	2/2	5/23	1/12	6/14	28	32	22	15	×	×	18	63	178	×
	Total	3/2	6/9	8/12	24/13	41/57	46/38	49/23	75	69	28	19	—	13	177	154	522	357
OXYOPIDAE																		
Oxyopes sp.	BB	—	—	—	—	—	—	—	1	—	—	—	—	—	0	0	1	1
SALTICIDAE																		
Maevia sp.	BB	—	1/0	—	—	—	—	—	—	—	—	—	—	—	1	0	1	1
Total No. of individuals	TS	4/2	4/1	12/5	15/1	25/22	30/19	17/2	20	32	13	25	26	46	107	52	249	321
	BB	0/4	5/4	1/3	7/10	21/13	27/11	24/3	34	19	6	18	17	37	85	48	210	264
	BN	—	3/1	6/6	10/5	12/4	11/8	8/6	6	8	3	19	17	39	51	30	116	173
	G	7/3	31/8	13/12	8/10	9/25	9/14	6/23	30	32	26	60	×	×	83	95	326	×
	Total	11/9	43/14	32/26	40/26	67/64	77/52	55/34	90	91	48	122	60	122	326	225	901	758
Total No. of Spider species per month	TS	1/1	2/1	2/1	1/1	1/2	3/2	2/1	3	3	1	2	1	4	4	3	9	10
	BB	0/1	2/2	1/1	3/1	2/1	2/1	1/1	3	2	1	2	2	5	5	2	10	12
	BN	—	1/1	3/1	1/2	2/1	1/1	2/2	4	1	1	3	2	3	5	5	8	8
	G	1/1	2/1	1/3	1/1	2/1	3/2	1/1	2	1	1	4	×	×	4	5	7	×
	Total	1/1	3/4	4/5	4/3	5/3	5/3	2/3	9	5	1	4	3	6	9	9	19	20

Habitat	1971 Aug. 2/2	Sept. 4/4	Oct. 5/5	Nov. *4/4	Dec. *5/5	1972 Jan. 4/4	Feb. 4/4	Mar. 0/5	Apr. 0/4	May 0/4	June 0/5*	July 0/5*	Aug. 0/5*	Totals: Aug. 71 - Feb. 72 Nasib.*	Bura.	Aug. - June (Villages combined)	Aug.- Aug.
PHALANGIDAE																	
Total No. of individuals TS	—	—	—	2/1	1/3	1/1	1/1	7	1	—	1	—	1	5	6	20	21
BB	—	3/0	1/0	—	1/0	0/1	1/0	—	—	—	—	—	1	6	1	7	8
BN	—	—	0/1	—	0/1	—	0/1	1	—	—	—	—	—	0	3	4	4
G	—	0/1	—	—	0/1	1/1	—	2	—	1	—	×	×	1	3	7	×
Total	—	3/1	1/1	2/1	2/5	2/3	2/2	10	1	1	1	—	2	12	13	38	33

TS = Tree-shrub; BB = Bamboo; BN = Banana; G = Grass.
* The Nasibpur Grassy Plot was trapped only 2 times in November and 2 times in December. No trapping was done on the Burasanti Grassy Plot in July and August of 1972, and in June it was trapped only 4 times.

shrub, bamboo and grass habitats there was a tendency for the mean number of individuals per species to be higher when the number of species was low, and to be low when the number of species was high (Table 4).

There were three different patterns of distribution of the spider species (Table 4). The three species that were present in all four of the habitats (Table 5) were the ones which were the most active, i.e., the species most frequently caught in the pit-fall traps. Those species which occurred in two or three habitats occurred with moderate frequency in the traps, with 3 to 24 individuals caught per species, and could be considered moderately active on the ground. Those species that occurred in only one habitat occurred with very low frequency in the traps, with only 1 to 3 individuals caught per species. These least active or low frequency species accounted for 63 per cent of the spider species caught, but accounted for only 2.1 per cent of the individuals. The number of moderate and high frequency species was similar, but the high frequency species accounted for 93 per cent of the spiders caught (Table 4).

The species composition of the spider fauna in each of the four habitats differed mainly because of the low frequency species, which occurred in only one habitat each (Table 4). The bamboo, banana and grass habitats shared two of the species that occurred with moderate frequency, and the banana and grass habitats each shared one moderate frequency species with the tree-shrub habitat.

Seasonal changes in Spider activity on the Ground

The number of species present varied during the year. The months with the most species active on the ground were October 1971, eight species, and March 1972, nine species. In August 1971 and May 1972 only one species was present: *Lycosa sumatrana* in August and *L. birmanica* in May. The average number of species present in the study per month was 5.0, and the average per month in each habitat was 2.1.

The number of spiders active on the ground gradually increased during the course of the study, but did exhibit wide fluctuations (Fig.

TABLE 3

SPIDER SPECIES DIVERSITY ON THE GROUND WITHIN AND ACROSS SEASONS, HABITATS AND VILLAGES

Village and Seasons	Habitats Tree-shrub	Bamboo	Banana	Grass	Total
Nasibpur					
Sept.-Nov.	1.42	2.41	1.75	1.25	1.94
Dec.-Feb.	1.54	0.98	0.75	1.64	1.44
Sept.-Feb.	1.50	1.37	1.37	1.82	1.79
Burasanti					
Sept.-Nov.	0.99	1.38	1.61	1.75	2.10
Dec.-Feb.	1.08	0.00	1.61	0.87	1.17
Mar.-May	1.46	1.30	1.44	0.44	1.31
June-Aug.	1.00	1.07	1.29	1.87*	1.49*
Sept.-Feb.	1.26	0.97	1.73	1.60	1.72
Mar.-Aug.	1.48	1.75	1.64	1.45*	1.81*
Sept.-Aug.	1.66	1.78	1.87	1.67*	1.97*

* No data for July and August on the grassy plot.

TABLE 4

STRUCTURE OF SPIDER COMMUNITY IN TERMS OF DISTRIBUTION AND ABUNDANCE OF INDIVIDUALS AND SPECIES (AUGUST 1971-JUNE 1972)

	Mean No. of Individuals per Species and (No. of Species) In relation to No. of Habitats Species Occurred In One	Two	Three	Four	For each habitat	% of Individ.	% of Species
Tree-shrub	1.8(4)	3.0(2)	—	78.0(3)	27.5(9)	27.1	47.7
Bamboo	1.4(5)	—	1.0(2)	67.0(3)	21.0(10)	23.1	52.6
Banana	1.0(2)	3.0(1)	5.5(2)	33.3(3)	14.5(8)	12.7	42.1
Grass[1]	3.0(1)	17.5(1)	1.5(2)	104.7(3)	48.2(7)*	37.1*	36.8
Mean No. of individuals per species and (tot. no. of species)	1.6(12)	13.3(2)	8.0(2)	283.0(3)	47.95(19)	100.0	100.0
% of individuals	2.1	2.9	1.8	93.2	100.0	911	—
% of species	63.2	10.5	10.5	15.8	100.0	—	19

* chi square $p < .001$.

[1] Number of spiders adjusted due to fewer number of trap days.

TABLE 5

DISTRIBUTION OF ARANEAE AND PHALANGIDAE ACROSS HABITATS AND PER CENT OF POPULATION FOR ELEVEN MONTHS (AUGUST 1971 - JUNE 1972)

Scientific name	Per cent of each habitat: Tree-shrub site	Bamboo grove	Banana grove	Grassy plot 1	Number of individuals	Per cent of population: By species	By family
CTENIZIDAE							
Acanthodon sp.	—	(100)	—	—	(1)	See text	
THERAPHOSIDAE							0.3
Phlogiodes validus	100	—	—	—	3	0.3	
OONOPIDAE							0.1
Diblemma sp.	—	—	100	—	1	0.1	
GNAPHOSIDAE							4.3
Drassodes malodes	—	100	—	—	1	0.1	
Drassodes oppenheimeri	14	8	16	62**	37	4.1	
Gnaphosa sp.	100	—	—	—	1	0.1	
THERIDIIDAE							0.3
Cyllognatha sp.	—	100	—	—	2	0.2	
Theridion sp.	—	—	100	—	1	0.1	
THOMISIDAE							0.4
Thomisus cherapunjeus	—	100	—	—	1	0.1	
Thomisus sp. (juveniles)	—	—	33	66	3	0.3	
Xysticus minutus	100	—	—	—	1	0.1	
HETEROPODIDAE							0.7
Heteropoda sp.	50	—	50	—	6	0.7	
CLUBIONIDAE							0.2
Castianeira sp.	—	100	—	—	2	0.2	
LYCOSIDAE							93.3
Lycosa annandalei (adults)	—	—	—	100	3	0.3	
Lycosa birmanica (adults)	36	16	11	37**	183	20.1	
Lycosa nigrotibialis (adults)	100	—	—	—	2	0.2	
Lycosa sumatrana (adults)	31	24	5	40**	107	11.7	
Lycosa tista (adults)	13	—	—	87	8	0.9	
Lycosa sp. (adults)	—	8	83	8	12	1.3	
Lycosa spp. (juveniles)	25	27	13	36**	535	58.7	
OXYOPIDAE							0.1
Oxyopes sp.	—	100	—	—	1	0.1	
SALTICIDAE							0.1
Maevia sp.	—	100	—	—	1	0.1	
Total Araneae	27	23	13	37**	911	99.8	99.8
PHALANGIDAE	53	18	11	18*	38	100.0	100.0

*) $p < .01$ and **) $p < .001$ using chi square that such a distribution would occur by chance.
1) Number of spiders adjusted due to fewer number of trap days.

2). The study can be divided into two parts, August 1971 to February 1972, when the activity was low to medium, and March to August 1972, when the activity was medium to high. The major fluctuations were due to changes in the activity of the lycosid spiders, which accounted for 93.3 per cent (Table 5) of the spiders caught (Fig. 2). The adults of the two species, *L. birmanica*

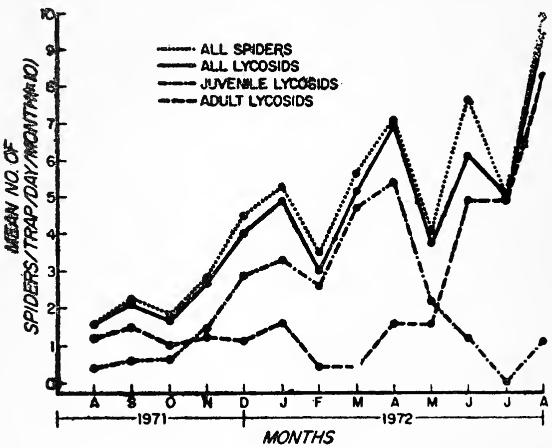

Fig. 2. Monthly changes in spider activity measured in terms of mean number of spiders per trap per day per month (× 10) between August 1971 and August 1972.

and *L. sumatrana*, accounted for 31.8 per cent of the spiders caught. Juvenile lycosids (excluding spiderlings), which can be attributed primarily to these two species, accounted for 58.7 per cent of the spiders. Thus, the adults of these two species, and primarily their young, made up 90.5 per cent of the spiders collected (Table 5). The adult lycosids were least active during February and March 1972, but increased rapidly in activity thereafter (Fig. 2). The juvenile lycosids had two peaks of activity: one in December and January, and the other in March and April. Juveniles of *L. sumatrana* and *L. birmanica* were collected during both periods. Unfortunately, since most juveniles were not identified to species, it could not be determined whether the activity at one time of the year could be attributed to a single species. This bimodal distribution of juvenile activity occurred in all four habitats (Fig. 3). The drop in juvenile lycosids caught after June (Fig. 2) is due to the fact that no collections were obtained from the grassy plot during July and August. During the previous two months, May and June, more than 75 per cent of the juvenile lycosids were collected from the grassy plot (Fig. 3). The increased in juvenile lycosids during August (Fig. 2) reflects their sudden reappearance on the ground in the tree-shrub, banana and bamboo sites, possibly indicating a shift from the grassy habitat (Fig. 3).

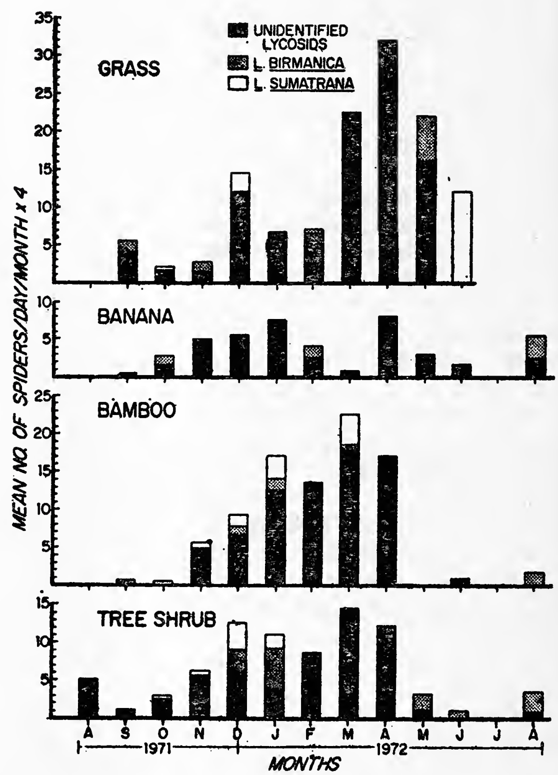

Fig. 3. Mean number of juvenile lycosids caught per day per month (× 4) between August 1971 and August 1972 in all habitats.

The Species

During the first 11 months of the study 12 species occurred at low frequency (from one to three individuals) in the traps and each was found in only one habitat (Tables 2, 4 and 5): *Castianeira* sp. (1 male, 1 female), *Cyllognatha surajbae* Patel & Patel (1 male, 1 female), *Diblemma* sp. (1 juvenile), *Drassodes malodes* Tikader (1 male), *Gnaphosa* sp. (1 male), *Lycosa annandalei* Gravely (3 females), *Lycosa nigrotibialis* Simon (2 females), *Maevia* sp. (1 male), *Oxyopes* sp. (1 male), *Phlogiodes validus* Pocock (1 juvenile, 2 males), *Theridion* sp. (1 juvenile female), and *Xysticus minutus* Tikader (1 female). One additional low frequency species occurred in the last month of the study: *Acanthodon* sp. (1 male). In August 1972 one juvenile and seven adult male *Diblemma* sp. were captured (Table 2), which indicates that this species should actually be considered with those that occurred with a moderate frequency in the traps.

Four species did occur in the traps with moderate frequency (4 to 19) during the first 11 months of the study and were present in two or three of the habitats (Tables 2, 4 and 5): *Heteropoda* sp. (6 juveniles), *Lycosa tista* Tikader (11 juveniles, 2 males, 6 females), *Lycosa* sp. (12 males, 3 females), and *Thomisus cherapunjeus* Tikader (3 juveniles, 1 male). The most numerous of these four species was *L. tista,* 84 per cent of which were captured in the grass habitat (Fig. 4). This species had a habitat niche breadth of 0.63. Except for *Lycosa* sp., the adults of these species occurred only during the cool dry time of the year (Table 2).

Three species occurred with a high frequency (39 and above) in the traps and were captured in all four habitats (Tables 2, 4 and 5): *Drassodes oppenheimeri* Tikader, *Lycosa birmanica* Thorell, and *L. sumatrana* Thorell. These three species had habitat niche breadths of 1.54, 1.84 and 1.82, respectively. *D. oppenheimeri* accounted for 3.6 per cent of the spiders collected, whereas the adults of the two lycosid species accounted for 31.8 per cent. The

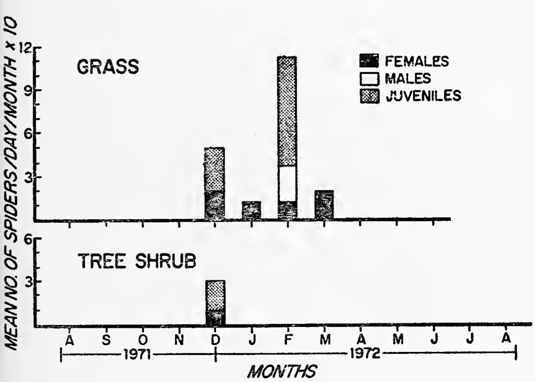

Fig. 4. Mean number of individuals of *Lycosa tista* caught per day per month (× 10) between August 1971 and August 1972 in all habitats.

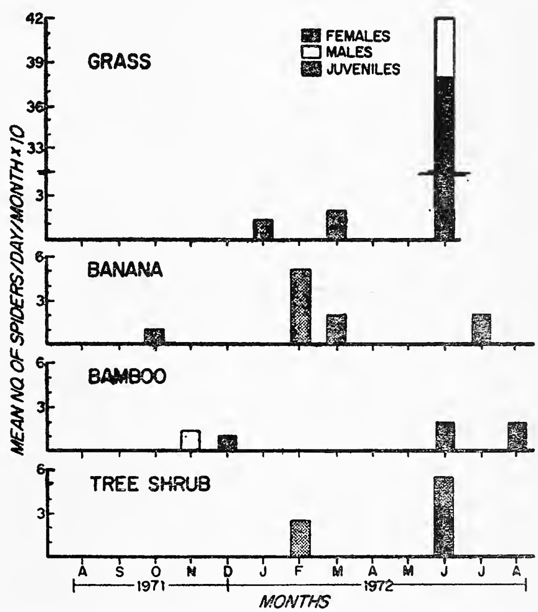

Fig. 5. Mean number of individuals of *Drassodes oppenheimeri* caught per day per month (× 10) between August 1971 and August 1972 in all habitats.

adults of these three species were caught in the traps primarily during the warm wet months (Figs. 5, 6 and 7).

D. oppenheimeri had an adult sex ratio on the ground of 1 male to 8.3 females, based on 28 adults. The males and females occurred most frequently during the hot wet months, particularly in the grass habitat, whereas the juveniles were most abundant during the cool dry months, particularly in the banana grove and did not occur at all in the bamboo grove (Fig. 5). It was unfortunate that no traps were set on the grassy plot during July and August, 1972, as this species had shown a preference for that habitat (df = 3, chi square = 27.8, $p < .001$).

If one includes some of the unidentified lycosid juveniles (Tables 2 and 5), *L. birmanica* probably accounted for over 50 per cent of the spiders collected. Only 52 of the 546 juvenile lycosids, however, could be identified or attributed to this species. The overall sex ratio was 1 male to 1.7 females, based on 323 adults; however, the ratio was lower in the tree-shrub (1:1.6, N = 126) and bamboo (1: 1.5, N = 70) habitats, and higher in the banana

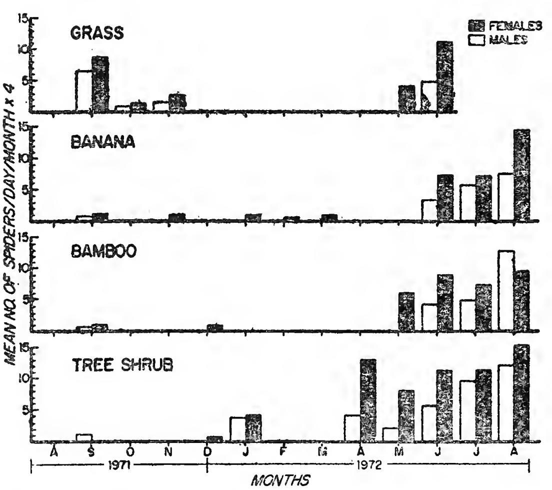

Fig. 6. Mean number of adult *Lycosa birmanica* caught per day per month (× 4) between August 1971 and August 1972 in all habitats.

TABLE 6

NUMBER OF FEMALES CAPTURED WITH EGG SACS AND SPIDERLINGS IN EACH HABITAT DURING STUDY*

	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Total No. of females
L. birmanica														
Egg sacs	—	—	—	—	—	—	—	—	—	1G	—	—	2BN	3
Spiderlings	—	—	—	—	—	—	—	—	1TS	1TS	1BN	—	1BB 1BN	5
L. sumatrana														
Egg sacs	—	—	—	—	—	—	—	—	—	—	—	—	—	0
Spiderlings	—	—	—	1BN	1BN	—	—	—	—	—	1G	—	—	3

* TS = Tree-shrub, BB = Bamboo, BN = Banana, G = Grass

(1:2.1, N = 65) and grass (1:1.8, N = 62) habitats. This species showed a strong preference for the tree-shrub and grass habitats (df = 3, chi square = 40.41, $p < .001$). Except for August 1971, adults of this species were present on the ground throughout the study (Fig. 6). The activity was low on the ground for the first eight months, but starting in April it increasd fairly rapidly and reached a much higher level (df = 3, chi square = 695.8, $p < .001$). Females with egg sacs or spiderlings were captured between April and August 1972 (Table 6). The largest numbers of spiderlings removed from a trap were 13, 22, and 25. During the months when both villages were trapped, this species was 3.7 times more abundant in Nasibpur (adjusted N = 75), but the habitat niche breadths were similar: 1.47 in Nasibpur and 1.42 in Burasanti.

L. sumatrana probably accounted for over 30 per cent of the specimens collected, if one includes some of the unidentified lycosid juveniles (Tables 2 and 5); however, only 52 of the 546 juvenile lycosids could be identified as or directly attributed to this species. When adults were present on the ground, females

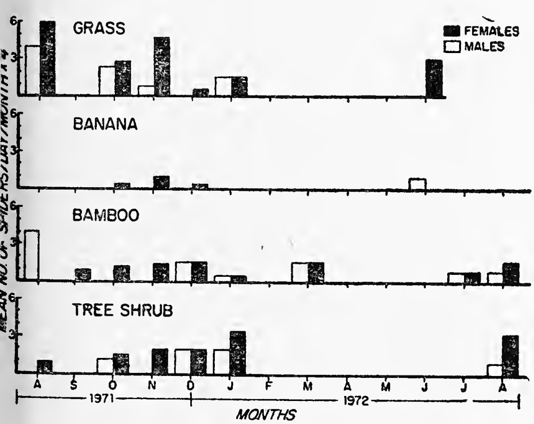

Fig. 7. Mean number of adult *Lycosa sumatrana* caught per day per month (× 4) between August 1971 and August 1972 in all habitats.

tended to be more frequent than males (Fig. 7), with a sex ratio of 1 male to 1.8 females based on 115 adults; however, the ratio was lower in the bamboo habitat (1:1.4, N = 31), and higher in the tree-shrub (1:1.9, N = 38), grass (1:1.9, N = 41) and banana (1:4.0, N = 5) habitats. The adults were most active on the grassy plot and least active in the banana grove (df = 3, chi square = 29.0, $p < .001$). Adults were collected in all months of the year, except for February, April and May (Table 2). The activity showed strong seasonal fluctuations (df = 3, chi square = 30.75, $p < .001$), and tended to be high between August 1971 and January 1972 (Fig. 7). The activity was low from February to May and then increased again gradually from June to August. Three females carrying respectively 15, 18 and 34 spiderlings were captured from the banana and grass habitats (Table 6). During the months when both villages were trapped, this species was 3.3 times more abundant in Nasibpur (adjusted N = 99), and the habitat niche breadth was wider in Nasibpur (1.66) than in Burasanti (1.21).

THE GROUND ACTIVITY OF HARVESTMEN

During the initial phase of the study when collections were made at both villages 25 phalangids were caught (Table 2). They occurred almost equally in the two villages, with 52 per cent in Burasanti, but the habitat niche breadth was wider in Burasanti (1.78) than in Nasibpur (1.33).

Thirty-eight phalangids were collected during the first 11 months of the study, and were most active on the ground in the tree-shrub habitat (df = 3, chi square = 16.11, $p < .01$). They were next most active in the bamboo grove and on the grassy plot, and were least active in the banana grove (Tables 2 and 5). Phalangids were active on the ground in all months, except August 1971 and July 1972,

and were most active during March in the tree-shrub site (Fig. 8). In Burasanti phalangids

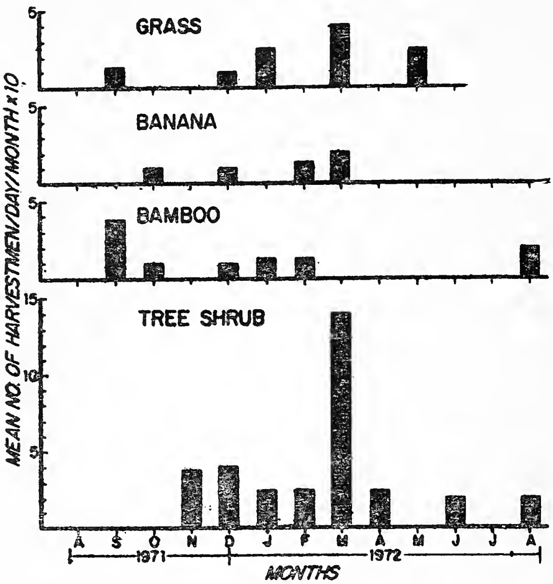

Fig. 8. Mean number of harvestmen caught per day per month (× 10) between August 1971 and August 1972 in all habitats.

had an overall habitat niche breadth of 1.73, which was slightly less than that of spiders, 1.91.

Discussion

Taxonomy and Distribution

As mentioned in the introduction the spider fauna of tropical areas is still being described. In this study the geographic distribution for a number of species have been increased and at least one new species was found. The two specimens of *Castianeira* sp. represent the first report of the subfamily Micariinae for India. Three species, *Cyllognatha sarajbae, Lycosa nigrotibialis* and *Phlogiodes validus* have previously only been reported from western India (Patel & Patel 1972; Pocock 1900). *Lycosa tista* was collected previously about 370 km to the north of the present study site, along the Tista River in Sikkim (Tikader 1970), whereas *Drassodes malodes* was previously collected 40 km to the south of the present study site in Calcutta (Tikader 1962). *Drassodes oppenheimeri* is presently only known from the site of this study (Tikader 1973).

Interpretation of Pit-fall trap data

A number of factors, such as seasonal vertical and horizontal migrations, timing of the diel trap period, and trap-site area and heterogeneity may place restrictions on the ecological interpretation of the results.

Pit-fall trap data in particular are subject to a number of limitations. Those species which make extensive movements on the ground are more likely to be caught in the trap than those species which confine their movements to a web or to a small area around an ambush site or to objects above the ground, such as logs or foliage. Some species at certain times of the year may be more active in the vegetation than on the ground and this will be reflected in the trap records as periods of "abundance" and "rarity" (Merrett 1968; Williams 1962). Seasonal shifts from one habitat to another will introduce other discontinuities in the trap record (Edgar 1971a). Other species may be quite abundant on the ground at certain times of the year, but are in an inactive state at other times, usually during the winter or cool months. Therefore pit-fall trap data are indicative only of activity on the ground in the area around the traps in a particular habitat. They are not indicative of the age of maturity or actual abundance (Merrett 1967). This complexity of variables, plus the presence of winter and summer active age groups and species, probably explains the lack of clear cut trends in the species diversity within a habitat from one season to the next (Table 3).

The timing of the diel trap period may have

led to selective capture of spiders and harvestmen. Harvestmen are reported to be mainly nocturnal, with a number of species active crepuscularly and only a few active diurnally (Williams 1962). Thus the trapping period was biased in their favour, though relatively few were caught. Some lycosid spiders are diurnal in activity, and are more active in bright sunlight than in dull sunlight, whereas other lycosids may be active during crepuscular periods (Williams 1962). The trap period would thus appear to be biased against diurnal lycosids. But two of the six lycosid species nonetheless made up 91 per cent of the collection. These two species may have been caught primarily during the first and last 3 to 4 hours of the diel trapping period, if they were diurnal, or they may have been crepuscular in activity.

The trap-sites tended to be uniform for a particular vegetation type over a small area. This might tend to obscure the selectivity of the various species of spiders and harvestmen for habitat type. However, it has been demonstrated that habitat specificity can be detected within a three week period between two species of lycosids with one habitat as small as 6 m^2 (Duffey 1962), which is much smaller than the 50 m^2 trap-site habitats used in this study. In one study the average density of spiders in a meadow during the active period of the year was $45.5/m^2$, and that of one species of lycosid $9.05/m^2$ (Breymeyer 1967). Other studies have shown that the density of spider populations may range from 5 to over $840/m^2$ (Duffey 1962). Thus the trap-sites used in this study were probably large enough to demonstrate habitat specificity.

Although the banana groves were fairly uniform for habitat type, spider and phalangid activity was lowest there. The banana groves had the highest diurnal soil surface temperatures and possibly these were too extreme. These high temperatures occurred due to the lack of vegetation cover over the soil surface, which in itself may have made the habitat less attractive to the spiders.

Seasonal and Diel Activity Cycles

The seasonal and diel activities of spiders and harvestmen, and their presence in different habitats have been shown to be related to their sensitivity to the amount of moisture in the air. Some lycosids, particularly in the genus *Lycosa*, have a waterproof epicuticle which allows them to be active in dry situations, such as open scrub during diurnal periods in the summer, whereas harvestmen lack such an epicuticle and tend to be active in damp situations, such as woodlands during nocturnal periods in the winter (Williams 1962). To a certain extent this hypothetical situation occurs in the present study, at least in relation to habitat specificity. The adult lycosids of the two most active species were most frequently captured during the warm to hot months, particularly on the grassy plots. The harvestmen were most active on the ground in the tree-shrub habitats, and were most active during the cool dry months. Their peak of activity in March, which was dry, but warmer than the preceding months, may have been due to greater abundance of prey.

Overall spider activity was low in August 1971 as compared to August 1972. This was primarily due to the low activity of juvenile lycosids and the absence of *L. birmanica* adults in August 1971. The amount of rainfall in August 1971 was almost twice as much as that in August 1972 and frequently the soil surface was under water, whereas in the following year this was not the case. Also, it is known that during periods of heavy rain spider activity is reduced (Merrett 1968).

There were seasonal differences in the activity between those species that occurred with moderate frequency in the traps and those that occurred with high frequency. Three of the four moderate species tended to be active on the ground primarily during the cool dry months; and one of them, *L. tista,* had previously been reported only from the foothills of the Himalayas (Tikader 1970). Three of 19 commonly occurring species caught in England in a grassy dunes area were classified as winter active (Sudd 1972), and another species, *Hahnia helveola,* was found to mature at the start of and remain active throughout, the winter (Merrett 1968). The adults of the three species that occurred with high frequency in the traps were primarily active on the ground during the warm wet months: *D. oppenheimeri* in the late premonsoon, *L. birmanica* in the premonsoon and monsoon months, and *L. sumatrana* in the monsoon and postmonsoon months. It may be that those species that are active in the cool dry months as adults are unable to achieve population levels as high as those that are active in the warm wet months as adults. This could be brought about by the lower availability of prey during the cool months and to competition with phalangids and the larger juveniles of *L. birmanica* and *L. sumatrana* that are active at that time. Beetles and flies were most abundant during this study in the warm wet months (Oppenheimer 1972).

Fecundity and differences in the ground activity of males and females

Usually more adult males than females are caught during all or part of the year. If this high level of adult male activity is limited to one part of the year, it may correspond to the time when males are searching for a mate (Duffey 1962; Merrett 1967). This may be followed by a peak in adult female activity, which corresponds to movements involved in searching for suitable deposition sites for the eggs (Merrett 1967, 1968) and/or to periods when females carry their egg sacs and expose them to the heat of the sun, usually in open sun-lit areas (Edgar 1971a; Vlijm & Kessler-Geschiere 1967). It may be this sunning activity or the related preference for higher temperatures by adult females (Norgaard 1951) which accounts for the presence of more adult females than males of *D. oppenheimeri, L. birmanica, L. sumatrana* and *L. tista* on the grassy plot. The low number of adult males captured in comparison to the adult females in these species might be explained by the males tending to spend more of their time up in the vegetation, which would restrict them to the habitats with vertical structuring, i.e., the tree-shrub and bamboo habitats. It has been shown that adult females of *L. nigriceps* descend to the ground during maternal periods and are caught in greater numbers than are the adult males (Merrett 1968). A consistently higher capture rate of adult females in certain species has been reported in other studies (Breymeyer 1967; Merrett 1967).

Only a small number of adult females were caught with egg sacs or spiderlings. This may have occurred because females with egg sacs are less active, and because females carry spiderlings on their backs for only a week or less (Edgar 1971a). Thus these females would have a smaller chance of being caught in the traps than would unencumbered females (Vlijm & Kessler-Geschiere 1967). It could also be that egg sacs and spiderlings may be eaten by parents or other spiders after a certain period of stress in the traps.

In the temperate regions adult female lycosids may produce one, two or sometimes three egg sacs (Vlijm & Kessler-Geschiere 1967) during their one reproductive season. In Poland,

where the activity season is short, *Trochosa ruricola* females produce 163.9 eggs per egg sac, which on the average results in 53.6 spiderlings (Breymeyer 1967). In Scotland *Lycosa lugubris* produces on the average 34.5 spiderlings from the first egg sac and 16.7 from the second for a total of 51.2 (Edgar 1971b). The little data obtained in this study indicate that *L. birmanica* and *L. sumatrana* may have a reproductive season and fecundity that is similar to that of *L. lugubris* in Scotland. The reproductive season of *L. birmanica* may last from April to August, which would be sufficiently long for the production of two, or perhaps three, egg sacs.

Number of Species and comparison with Temperate Zone studies

Duffey (1962) has suggested that habitats with a high vegetation diversity will support a large number of spider species, whereas habitats with greater vegetation uniformity will support spider populations of high density but of fewer species. If the banana grove is omitted from consideration due to its extreme microclimate, the above relationship appears to be supported by this study. The grassy plot had the most uniform vegetation and had more individuals that were active on the ground per species than did the tree-shrub or bamboo habitats.

The number of species of spiders collected during this study (20) and the average number of species caught per habitat (9.5) was low when compared to similar studies in the temperate region. In a study on a 2.8 acre limestone grassland, consisting of three habitats, 141 species of spiders were caught, which is one-fourth of the total spider fauna known for England (Duffey 1962). Eighty of these species were caught in the pit-fall traps and the average number of species per habitat was 59. In other studies 46 species were collected in an open scrub area, 39 species in a woodland (Williams 1962), and 40 species in a chestnut forest with a beech understory (Russell-Smith & Swann 1972). In all of the above mentioned studies the family Linyphaeidae, whose members are known to build webs for the capture of prey, made up 50 to 72 per cent of the species caught. If only non-web building, cursorial species are considered, then the mean number of species caught per habitat was 23 (range 10 to 33), which is more than twice as many as were found in this study. The lycosids in the above studies accounted for 43 per cent of the cursorial species in each habitat (range 30 to 64%), and 55 per cent of the cursorial spiders (range 33 to 74%). In this study they similarly accounted for 45 per cent of the cursorial species (range 25 to 71%) in each habitat, but they made up 94 per cent of the cursorial spiders (range 93 to 96%). The average number of species caught per month in each habitat in England was 20.9 (Duffey 1962), which is ten times higher than in the present study.

Thus the species diversity of the spider fauna in the temperate zone studies was much greater than that found in this study done in a tropical region. This may be explained in part by differences in trapping procedure. In the temperate zone studies mentioned above the traps usually contained a preservative and thus were emptied at weekly or biweekly intervals. Thus the spiders were trapped continually throughout the day and year. This would give the rare or less active species a greater chance to be represented in the collection. Another possible reason for the low number of species in this study is that the habitats used here were highly disturbed. They were located for the most part within villages with large human and domestic animal populations. The grassy plots were more like lawns than meadows,

due to the constant grazing of cattle and goats. The banana groves were devoid of vegetation, except for the banana plants themselves, and the bamboo and tree-shrub sites were used for numerous activities by the villagers. One possible reason why the Nasibpur trap-sites had greater spider activity, and to some extent species diversity, than those in Burasanti may have been because the human population was less dense there and, therefore, there was less disturbance. Also Nasibpur received less rainfall, which might have allowed a higher level of spider activity. Insecticides are being used in the villages, but so far only to a minor extent.

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Census of the nilgiri tahr in the Nilgiris, Tamil Nadu[1]

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(*With a plate*)

Introduction

The census was taken during the middle of May 1975, before the onset of the S.W. monsoon, in near ideal conditions. The weather was warm without being hot and intermittant thunder showers had dispelled the mist which normally blanket the tahr country obstructing visibility. The exception, however, was the Mukerti belt which because of its location at the junction of the two arms of the cliff line became mist bound by midday. A carpet of young grass covered the rolling 'downs' beyond Bhavanipuzha after a recent fire had run through the country burning off the coarse grass.

This served as an invitation to the tahr to come out of their hideouts among the cliffs on to the plateau proper, thus accounting for the gathering of the tahr herds at Nadgani. The wind which is an important factor in the case of a sensitive nosed animal like the tahr was true and steady and not fickle. The horsefly season in the tahr country which could be a nuisance to man and beast driving away tahr to the shelter of sholas was, fortunately, delayed and was only just commencing when the count concluded.

Methods

The sight count method which is best suited for taking census of animals like the tahr which have a proclivity for open country was employed. Powerful binoculars and a telescope were used for taking the count. Registered Shikaris Susai and Bokkan who have experience of similar operations in the Nilgiris and elsewhere assisted. The ideal method would have been to have divided the country into four or five sections and to have conducted the count over the entire region simultaneously. However, for want of trained personnel this could not be done.

The Country was divided into four sections and every morning the enumerators fanned out into the section in which they were operating, each covering roughly a third of the section taking the count as they moved from one hill top to the next along the cliff line. Care was taken to ensure that there was no duplication and that no part of the section was left out. Each block was double checked, the enumerators changing places. At Nadgani which held a large population of tahr, this process was repeated a third time, keeping track of the main herds all the while. Particular attention had to be paid to this process as the strength and composition of the herds kept altering from day to day and in some instances from hour to hour.

[1] Accepted July 1975.

THE OPERATION

The census operation was conducted over a ten day period between 7-v-75 and 19-v-75, and divided into three parts, with brief refitment breaks in between. The four sections into which the tahr country was divided were:

1. Mukerti—comprising Nilgiri Peak—Terrace—Mukerti Peak, Chinna Mukerti and Be Betta (7th May to 10th May 1975).
2. Western catchment—comprising King Dhar, western catchment dams 1, 2 and 3, Igandi and Chatti Burrai (12th and 13th May 75).
3. Nadgani—comprising the entire area—South of Bhavanipuzha including Nadgani, Sausage Hill, Ankin Malai, Varatuparai and the ridges beyond Varatuparai and Simon Hut (15th May to 18th May 1975).
4. Bangi tappal—comprising Billithada waterfall, Kinakorai, Bangitappal ridge, Cruz (Crucifix Hill) and Chembar (18th and 19th May 1975).

It may be mentioned that many of these place names cannot be traced on any map, but are names handed down by generations of shikaris.

THE COUNT:

Section 1—MUKERTI

Classification

Locality	S.B.	B.B.	L.B.M. & A.F.	Yearling	Young	Total
Nilgiris Peak Terrace		Nil				Nil
Mukerti Slopes	1	1	7	3	4	16
Chinna Mukerti	—	1	5	3	1	10
Chinna Lower slopes	—	1	8	3	4	16
Be Betta	1	—	—	—	—	1
	—	—	2	—	—	2
	2	3	22	9	9	45

(An all male group of 4 saddlebacks were seen a week after the count and out of which one was shot).

Section 2—WESTERN CATCHMENT

Locality	S.B.	B.B.	L.B.M. & A.F.	Yearling	Young	Total
King Dhar	1	2	15	3	5	26
Between W.C. Dams 1 and 2	—	1	2	2	1	6
Igandi	1	1	7	1	—	10
	2	4	24	6	6	42

Section 3—NADGANI

Locality	S.B.	B.B.	L.B.M. & A.F.	Yearling	Young	Total
Nadgani	1	3	43	6	9	62
”	—	2	25	2	4	33
”	—	1	5	—	—	6

When first seen the herd consisted of 101 animals, which later split and the composition kept changing.

Varatuparai	1	—	—	—	—	1
,,	3	—	—	—	—	3
,,	1	—	1	—	—	2
,,	—	2	14	5	7	28
,,	—	2	11	4	3	20
,,	—	—	2	—	2	4
Ridge beyond Varatuparai	1	1	5	2	2	11
Sausage hill	—	—	1	1	—	2
Nadgani cliffs	—	2	8	1	2	13
Simon hut	1	2	15	2	2	22
	8	15	130	23	31	207

Section 4—BANGITAPPAL

Locality	S.B.	B.B.	L.B.M. & A.F.	Yearling	Young	Total
Billithadahalla waterfall	3	2	13	2	2	22
Cruz hill	—	—	4	—	2	6
Bangi ridge	—	—	4	4	2	6
Bangi slope	—	1	5	—	—	6
	3	3	26	2	6	40
Grand total	15	25	202	40	52	334

Classification:
The abbreviations denote
S.B.—Saddleback
B.B.—Dark brown male or Brown back
L.B.M.—Light brown male
A.F.—Adult female
Yearling—Slightly less than 1 year to about 2 yrs.
Young—Upto 9 months

The total number seen was 334. To make doubly sure that there was no duplication, two small herds of 15 and 11 seen in the proximity of the large herd of 101 after its break up was not included in the count. In spite of favourable conditions, it is not improbable that a hundred or more tahr remained out of sight and un-enumerated. The total population could therefore be estimated at around 450.

On the classification, it may be noted that although it was possible to place individual tahr in small herds and groups in their proper class, such degree of accuracy was not possible where large herds were concerned. In the classification itself some overlapping could not be avoided. No attempt was made to classify L.B.M. and A.F. separately as this would have slowed down the work considerably. But from samplings it was noted that the ratio between males and females in this class was roughly 1:3. Two male groups, both association between saddlebacks were seen. The majority of young were three to four months old, indicating a peak birth period during winter. There were another lot of kids eight to nine months old indicating a second peak in August-September. A few young of different ages from two months upwards were also seen.

Composition

Young accounted for 16 per cent of the population (rising to 20 per cent or more at times) thus indicating a healthy growth rate.

A yearling tahr
(*Photo*: *Author*)

But the percentage of yearling at 12 per cent, showed a decline in the rate of survival. This problem is discussed under predation.

1963 *and* 1975 *census, a comparative study*:

In 1963, 292 tahr were counted and the total population was estimated at 400 (*JBNHS 60*(1):251) compared to 334 and 450 for the present census—an improvement, but not a significant improvement in status. However, with the present 16 per cent growth rate the position may be expected to improve, unless conditions change. This problem is discussed elsewhere.

In 1969, George B. Schaller (*JBNHS 67*(3): 365-389) conducted a survey of the Mukerti and Bangitappal areas and reported that there was no improvement over the 1963 position.

	1963 census	1969 survey	1975 census
Mukerti	79	63	45
Western Catchment	66		42
Chembar	35		—
Bangi-tappal	47	113	40
Nadgani	65		207
	292		334

The distribution in 1963 as compared to 1975 was more even. Some of the notable areas where no tahr were sighted were Nilgiri Peak and Terrace; Chembar and Bison Swamp. Tahr population in Mukerti, King Dhar and Western Catchment Dams has declined. A sharp increase in the Nadgani population was observed. Although tahr can and do migrate from the Nilgiri Peak and Mukerti of the north-western limit of the tahr habitat to the Sispara end, in the south-west in actual fact tahr in Nilgiri Peak—Mukerti—Western catchment dam area tend to migrate locally in that stretch rather than cross over to the Bangitappal-Nadgani area. The same applies to the tahr in the south-western belt.

Opportunity was taken to check the Glenmorgan cliffs on the north-eastern edge of the plateau for tahr. None was found.

Sambar: Sambar have increased significantly, particularly in the Mukerti, Bangitappal, Simon Hut, Kinkorai and Nadgani areas.

Factors inhibiting growth

Habitat disturbance:

Since 1963 many new roads have been formed and wattle plantations have sprung up every where. Between Nilgiri Peak and Bangitappal, with the exception of Chinna Mukerti, wattle has been planted right up to the cliff line. Although the growth is poor and scraggy, because of these plantations grass had remained unburnt and consequently coarse and unpalatable to tahr—perhaps affecting the growth rate of the tahr. Had a belt of grassland been reserved as tahr grazing grounds, as requested by the Nilgiri Wild Life Association and as agreed to by the Forest Department, the position would have been different.

Large herds of cattle penned in the Tirupanthorai Hundi (near Western Catchment Dam No. 2) were being grazed on the hills adjoining the cliffs. The cattle and the graziers were up on the cliff line from about 8 a.m. until dusk. It is believed that this is an annual summer exodus. Thanks to cattle grazing and "accidental" (!) fires the grass on the surrounding hills had burnt down, promising good grazing for the tahr once the Hundi is vacated.

Predation

A large male black panther was seen on four occasions. Its habits and behaviour showed that it had become an expert tahr hunter concentrating on young and yearling strays. A female panther and its cubs were heard in a

shola near Nadgani. An examination of their fresh droppings showed that they had been feeding on a young tahr. Ten of the dozen panther droppings analysed contained hair and other remains of young and yearling tahr.

A pack of 8 wild dogs (dhole) were seen operating in the Mukerti area and a pack of 19 dhole was reported to be hunting in the upper Bhavani area. Evidence showed that the wild dogs were preying on sambar. The presence of dhole at two different places on the plateau at this time of the year seemed unusual as dhole migration to the plateau normally takes place in August-September.

Fresh tracks of two different tigers were seen. Two or three more were reported to be operating in the area. Of the eight tiger droppings examined only one contained the remains of tahr.

Poaching

Wherever human habitations abutted tahr grounds tahr suffered from a certain amount of poaching, as in the Nilgiri Peak area (from Terrace), Western Catchment Dams 2 & 3 (from Emerald Valley). At Kinakorai and Nadgani well set up poaching camps were found. These well stocked areas seemed to attract poachers from villages far and near. And also from Kerala via the Sispera pass.

It is a notable fact that practically in every instance the poaching cases that were detected or attempts at poaching that were aborted were at the instance of game licence holders.

Recommendations

1. Concentration of the tahr in any one area is bad. To encourage more even distribution, grasslands along the cliff line must be burnt annually. For this purpose some of the poor wattle plantations in the Nilgiri Peak, Mukerti, King Dhar, Western Catchment and Bangitappal areas may have to be sacrificed. Seeing how scraggy and unhealthy these plantations are, the sacrifice in terms of forest 'wealth' may be negligible.
2. The country beyond Bhavanipuzha, which is in any event, unsuitable for planting should be left undeveloped as a tahr wilderness.
3. Poaching in the areas mentioned must be eliminated. Periodical visits and patrols must be organised. As Silent Valley in Kerala opens up and of which there are already indications, the tahr habitat will become a sensitive area.
4. Tigers are reported to be taking regular toll of cattle in the Emerald and Avalanche Valleys, Korakundah and elsewhere on the western side of the plateau. And leopards around Thiashola and Korakundah.

As cattle cannot be eliminated from these areas the scheme for paying compensation to owners of cattle killed by leopards and tigers must be extended to the plateau if the carnivore there are to be saved, and they in turn are to keep the tahr population in balance.

5. Since Nilgiri Tahr will be covered by the special game licence, under the New Wild Life (Protection) Act, of 1972 a ceiling on the total number of saddle backs that may be bagged in a year could be placed to prevent over shooting. This may be fixed at four annually or two every half year, with no provision for carry over. Being a renewable "crop" this is a conservative figure for culling. A half yearly limit is suggested for more even spacing of the shooting and encourage visits to the tahr country throughout the year.

Tahr sanctuary

It is believed that the formation of a tahr sanctuary in the Nilgiris is under consideration. A few thoughts on the subject may not be out of place in this report.

The object of setting up a sanctuary is to afford protection to wild life within its boundaries and incidentally provide amusement and education to visitors, whether this objective will be better served by changing the present set up has to be critically examined before a decision is taken, as the future of the tahr on these hills might well depend upon the nature of decision taken.

Only Saddlebacks are allowed to be pursued on the game licence. These account for 5 per cent (approximately) of the tahr population. So straight away 95 per cent of tahr are placed on the protected list

On an average one Saddleback was shot between 1968-69 and 1973-74 game returns (4 in 1974-75) annually. It has been observed that about 50 per cent of the saddlebacks are true solitaries seldom taking part in breeding activities. Biologically the shooting of Saddlebacks, as hither to, is likely to have little effect on the status of the species. In any event, a fair proportion of the breeding is done by brown bucks.

Securing a Saddleback trophy is an often an arduous task. To get these few trophies at least two dozen trips are made into the tahr wilderness, not counting the 'marking' trips made by registered shikaris. Otherwise no one, not even forest guards (with few exceptions like myself on study cum photographic cum fishing trips) has been known to visit the remote tahr areas. The value of these shikar expeditions cannot be under estimated. There is ample evidence to prove that detection of poaching cases and thwarting attempts at poaching in this wilderness was mainly due to the initiative of game licence holders.

So far as game licence holders are concerned it is easy to keep a check on their activities as their entry and exit points are known and well covered. Besides, it is observed that the bulk of the licence holders going in pursuit of the Saddleback are sportmen looking for a trophy and not 'Jeep Hunters' hunting for the pot.

This being the case will the status of the tahr improve by closing the area to shooting? On the contrary, the chances are that the position will deteriorate rather than improve by banning shooting in the tahr country. This view is shared by Dr. Schaller and others who are aware of the special problems relating to the preservation of the tahr. Basically a tahr sanctuary is different from sanctuaries for other forms of wild life. The tahr habitat is wild, mountainous and tough. Climatic conditions are extremely hostile at times. Proper patrol and supervision of a tahr sanctuary is difficult unless a set of extremely dedicated, conscientious and superbly fit game guards could be found. The officers in charge of the sanctuary also have to be equally keen, dedicated and physically absolutely fit. Otherwise the sanctuary will become a poachers' paradise, particularly in view of the inroads that may be expected into the area from Kerala in the not too distant future.

The sad experience with regard to the Glen Morgan herd, and the Palni Hills tahr where the numbers dropped dramatically from over one thousand to a mere fifty (figures based on a survey conducted by me in 1973) in the past twenty years, most of the deterioration taking place after the banning of shooting ought to put the authorities on their guard. There are other such examples also like the Kodayar in the Mundanthorai tiger sanctuary.

Strangely tahr have flourished wherever private initiative took a hand in protecting the species by management. This included strictly regulated shooting and permitting only the shooting of Saddlebacks. The tahr on the Nilgiris, Eravikulam on the High Range in

Kerala, Grass Hills in the Anamalais, and Highwavys are cases in point.

It may be noted that tahr sanctuaries have been set up in the Grass Hills in the Anamallais in Tamil Nadu and in Eravikulam in Kerala. The progress of these sanctuaries may be watched.

So far as visitors are concerned, even now there is nothing to prevent them from visiting the tahr country and looking at the animals in their natural state. There are many tahr for every one to see. However, in view of the exertions that this exercise involves few people care to indulge in this pastime. The setting up of a sanctuary is not likely to engender a greater interest and awareness in the tahr. Also, the disturbance caused by visitors in the open country frequently by tahr would be counterproductive to visual observation. Unfortunately visitors to sanctuaries usually bring with them noisy transistors and behave in a manner totally unsuited to the essential quietness the observation of this shy animal demands. Any encouragement of such incursions into the areas the Tahr inhabits would be a violation of this wonderful country and an insult to this fine animal. These trippers cannot in any event be expected to operate beyond the periphery of a tahr sanctuary and the remoter regions are likely to be neglected.

In the circumstances the best course would be to enclose a small hill close to Ooty (preferably in the Parson's Valley) and create a park for mountain game, including the Nilgiri tahr as the West Bengal Government has done in Darjeeling, to enable visitors to see the tahr for themselves without much exertion.

Acknowledgement

I am grateful to the Nilgiri Wild Life Association for providing me the opportunity and for the assistance given to conduct the census.

Orchids of Nepal—10[1]

M. L. Banerji[2] and B. B. Thapa[3]

(*With eight text-figures*)

[*Continued from Vol. 72*(1):42]

In this concluding instalment on the orchids of Nepal, the genus *Orchis* which is placed under tribe Ophryoidese—subtribe Platanthereae, is treated. Besides we have added some more plants that so far baffled determination and as such were held up for inclusion at the proper places. We have here recorded some of our observations on the lip structure of *Dendrobium eriaeflorum* which has also appeared previously.

Orchis Linn.

The name bears reference to the tuberoids which are of the shape of testicles. But some species bear palmate tubers which bear no such resemblance. Plants are terrestrial with two to many leaves. Flowers of *Orchis* are mostly pink or purple.

Artificial key to the species of *Orchis*

Lip deeply 3 lobed; floral bracts as long as the ovary. Stem slender, leaves 1-3 .... *chusua*

Lip shallowly 3 lobed; floral bracts exceeding the ovary—

Flowers smaller, pinkish; lip not spotted. Tubers digitate .... *habenarioides*

Flowers large, purple; lip usually spotted. Tubers palmate .... *latifolia*

Orchis chusua[4] D. Don, Prodr. Fl. Nep. 23, 1825; F.B.I. 6:127, 1890; King & Pantl. 303, t. 402, 1898; Hara 191, 1971. (Fig. 1).

Terrestrial plants 15-20 cm high, stem with usually two leaves; leaf oblong-lanceolate, upper leaf smaller. Spike 3-5 flowered, bracts lanceolate and as long as the ovary. Flowers purple, lateral sepals lanceolate, acuminate, reflexed dorsal sepal much smaller and resting on the petals; petals shorter, ovoid, obtuse. Lip longer than the sepals, variable in breadth but usually broader than long, 3 lobed, lobes spreading broad, rounded erose or crenate, rarely oblong with the midlobe retuse, spur cylindric, slightly clavate, adpressed to the ovary, equalling the ovary. Flowering during July-August. Collected from Lamjura, c. 3048 m, Dorzhong to Tsumdung, 3500 m, Thulo Gompha khola, 3700 m, Tsunje, 3600 m (Kitamura).

King & Pantl. have described a var. *nana* which differs from the typical by its much smaller size, having a single leaf and midlobe of lip less deeply lobed. Also, Kitamura describes a forma *parva* collected from Manaslu, 3800 m.

O. habenarioides King & Pantl. Ann. Roy. Bot. Gard. Calc. 8:302, t. 401, 1898; Duthie, Orch. North-West Himal. 172, 1906. *Gymnadenia orchidis* & *G. violacea* Lindl. Gen. et Spec.

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[4] According to nomenclatural changes effected by Hunt, the correct name of the plant should be *Chusua roborowskyi* (Maxim) P.F. Hunt in Kew Bull. 28:175, 1971; and the variety as *nana* (King & Pantl.) P.F. Hunt.

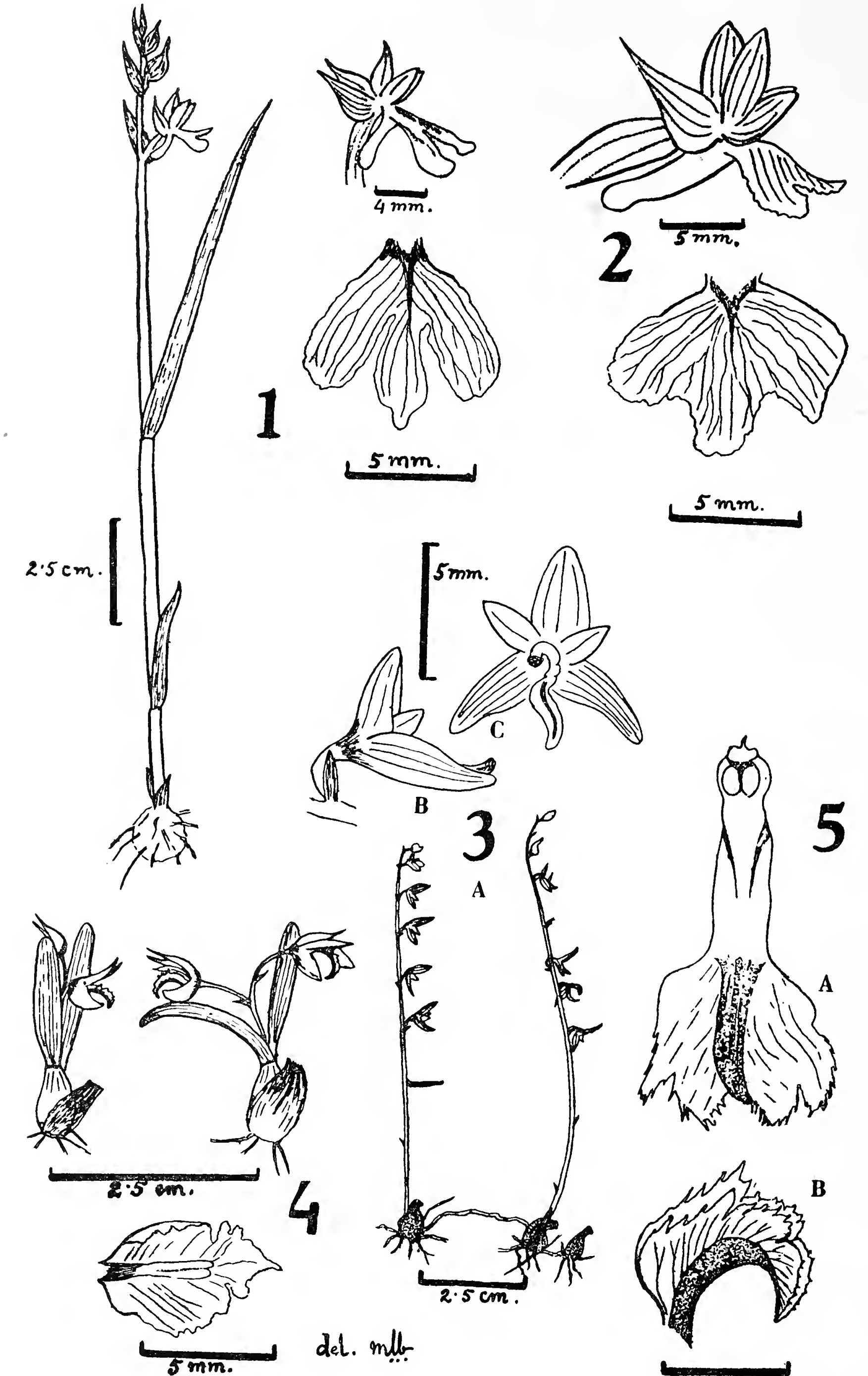

Fig. 1. *Orchis chusua* D. Don; Fig. 2. *Orchis habenarioides* King & Pantl.; Fig. 3. *Bulbophyllum polyrhizum* Lindl.; Fig. 4. *Dendrobium pygmaeum* Lindl.; Fig. 5. a, b. *Dendrobium eriaeflorum* Griff.

Orch. 272, 1835. *Habenaria orchides* Hk. f. in Fl. Brit. Ind. 6:142, 1890. (Fig. 2).

Plants 12-20 cm high, stem with digitate tubers and 4-5 leaves; leaf elliptic-oblong to oblong lanceolate. Spike densely flowered, 6-9, bracts lanceolate, longer than the curved ovary. Flowers pinkish, lateral sepals spreading, acute, dorsal sepal forming a hood with the petals; petals shorter than the sepals. Lip broadly oblong, base truncate, apex broad, 3 lobed, erose, spur shorter than the ovary, curved and slightly clavate. Flowering during August. Collected from Namchee to Thyangbochee, *c.* 3810 m.

It appears that this species is of rare occurrence.

O. latifolia Linn. Sp. Pl. 941, 1753; F.B.I. 6: 127, 1890; Duthie, Orch. North-West Himal. 172, 1906; Parker, Forr. Bull. bot. ser. 76, 1931. *Orchis hatagire* D. Don, Prodr. Fl. Nep. 23, 1825.

Plants stout usually fistular with palmate tubers. Leaves many upto 12 cm long. Spike dense flowered. Flowers dull purple, sepals and petals acute or obtuse, lateral sepals ovate, reflexed. Lip oblong or rhomboid, crenate, entire or very obtusely 3 lobed, sides deflexed, spotted with darker purple, midlobe small or obsolete; spur straight or curved, authority Parker.

Addenda and corrigenda

Bulbophyllum polyrhizum Lindl. Gen. et Spec. Orch. 53, 1835; F.B.I. 5:767, 1890; King & Pantl. 70, t. 45, 1898; Duthie, 104, 1906. (Fig. 3).

Rhizome thread-like, branched, pseudobulbs globular, *c* 2.5 cm apart; leafless when in flower; racemes inclined, 5-6 flowered; floral bracts minute equalling the stalk of the ovary. Flowers pale yellow; sepals spreading and unequal, lateral sepals longer, oblong-lanceolate, 3 nerved, dorsal sepal concave, ovate-oblong, smaller; petals much shorter than the sepals, ovate, 1 nerved. Lip deflexed from the base, oblong basal half grooved, foot short and slightly curved. Flowering during October. Collected only once from Trisuli khola area at *c.* 765 m.

In F.B.I. the colour of the flower is given as green and it is also mentioned therein that the drawing of the Sikkim plant shows the colour to be pale yellow. Duthie gives the flower colour as yellow. The specimen that we have collected had flowers with a pale yellow colour. Hara (1966 & 1971) has not listed this species, and from other relevant literature it appears to us that the plant has not been collected many times. We have collected this only once and under the circumstances we regard the species to be very rare in Nepal at least. Further, King & Pantl. on the basis of Gamble's material from Dehra Dun give the flowering time as April while Duthie basing on Mackinnon's material from Gharwal gives March as the time for flowers. We collected the material in flowers during the month of October. Lastly, the shape of the lip of our material does not match exactly with the drawings given by King & Pantl.; all these factors have been baffling us for a considerable time. Probably we disturbed the material while pressing.

Dendrobium alpestre Royle, this species we have listed in the 3rd instalment (*JBNHS 67*: 144, 1970), in the meantime we have come across certain nomenclatural changes. P. F. Hunt & V. Summerhayes name the plant as *D. monticola* (Taxon 10:110, 1961) while Hawkes & Heller call it as *D. roylei* (Orquidea 24:114, 1962).

Dendrobium eriaeflorum Griff. is another species which we have listed in the 3rd instalment. The material that was collected by us was not entered previously. It had been collected from

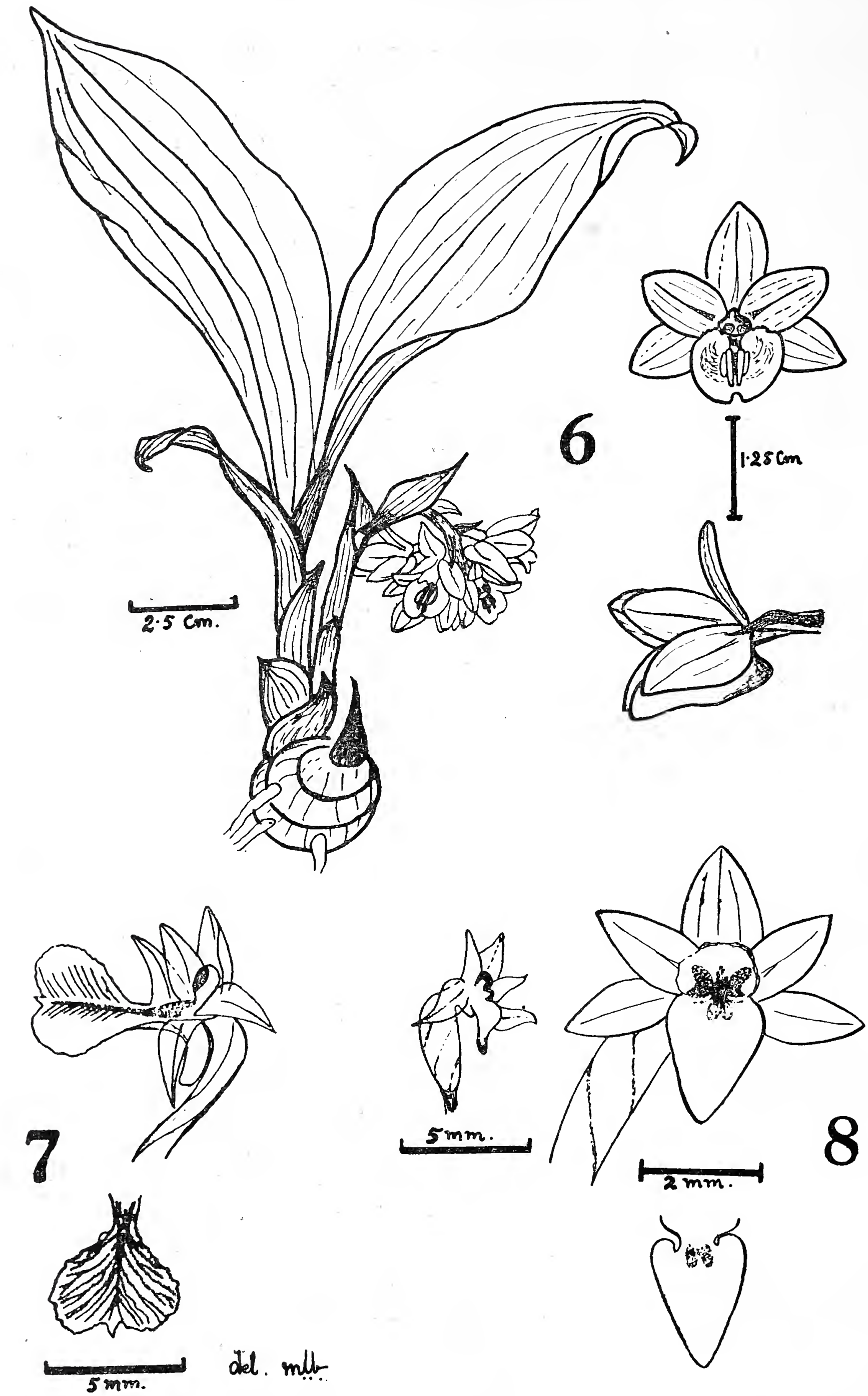

Fig. 6. *Geodorum densiflorum* (Lam.) Schltr.; Fig. 7. *Anoectochilus crispum* Lindl.; Fig. 8. *Herminium duthiei* Hk. f.

Risingo to Pheda, *c.* 1525 m, also from Yangsabesi to Naudanda (Pokhra valley), *c.* 1370 m.

Examination of the materials collected by us from Nepal show a degree of variation in the lip and is not quite exactly as figured by King & Pantl. The midlobe is fimbriate like the side lobes or it may be serrate along the margins (Figs. 5a, b).

Dendrobium pygmaeum Lindl. Gen. et Spec. Orch. 85, 1835; F.B.I. 5:717, 1890; King & Pantl. 43, t. 58, 1898. (Fig. 4).

Pseudobulbs 1.25-2.0 cm long, covered with scarious sheaths; leaves 2, terminal, linear-oblong, c. 3.75-6 cm long, sessile. Racemes terminal or subterminal, shorter than the leaves; floral bracts slightly exceeding the ovary. Flowers purplish, lateral sepals decurved, dorsal sepal erect; petals oblanceolate. Lip decurved at the apex, purple with veins of a deeper colour, sidelobes narrow and with a wavy margin, terminal lobe triangular, a fleshy ridge present on the lip. Flowering during October, only few specimens collected from Trisuli khola area *c.* 765 m.

Hara (1966, 1971) has not recorded this species and we have not been able to trace any specimen in the Central National Herbarium. This material has eluded proper identification for sometime. We take this species to be extremely rare and this is the first record of the species from Nepal.

Spathoglottis ixioides (D. Don) Lindl. which appeared in the 6th instalment (*JBNHS 69*: 289, 1972) was collected by us from Puyia forest, *c* 2895 m, and from Chepua ridge *c* 3810 m. These localities were not recorded previously and we regret the omission.

Geodorum densiflorum (Lam.) Schltr. in Fedde Repert Beih 4:259, 1919; *Limnodorum densiflorum* Lam, Encyl. 3:516, 1789; *Geodorum purpureum* R. Br. in Ait. Hort. Kew (ed. 2) 5:207, 1813; F.B.I. 6:17, 1890; King & Pantl. 181, t. 245, 1898; Duthie, 130, 1906; *G. dilatatum* R. Br. in Ait. Hort. Kew (ed. 2) 5:207, 1813; F.B.I. 6:17, 1890. (Fig. 6).

Terrestrial, rhizomes subglobose; leaves elliptical and tapering into sheaths which form a pseudostem, broad, plicate. Inflorescence shorter than the leaves, dense flowered; bracts lanceolate and longer than the ovary. Flowers pale purple, sepals linear oblong, 3 nerved, petals 5 nerved with the mid-rib thick, slightly broader than the sepals. Lip thickened towards the base as well at the apical lobe, dark purple markings on the lip, disc with bright yellow callus, apical lobe notched. Flowering during May to early July. Collected from Trisuli khola area at *c* 765 m.

This species should have appeared in the 6th (*JBNHS 69*, 1972) part of the series.

Anoectochilus crispus Lindl. in Journ. Linn. Soc. 1:180, 1857; King & Pantl. 297, t. 395, 1898. *Odontochilus crispus* Hk. f. in Fl. Brit. Ind. 6:99, 1890. (Fig. 7).

Plants decumbent, about 10-15 cm high, leaves few, ovate with undulate margins. Spike 4-6 flowered, flowers pink; bracts lanceolate, as long as the ovary; sepals unequal, lateral sepals spreading, oblong, dorsal sepal smaller with its apex turned backwards; petals conniving under the dorsal sepal. Lip deflexed from the base, apical lobe sub-rotund and divided into two broad lobules, with undulate margins. Flowering during August. Collected from Tarebhir to Nagi at *c* 1980 m.

King & Pantl. give the sepals as green, petals and lip as white, and the lip as tinged with yellow on the sac. In our material the petals and lip are pink like that of *A. roxburghii* but the lip is very different—the terminal lobe of the lip is divided into two lobules which are broad, have undulate margins and a mucronate apex, also the fimbrae are absent. The proper

place of this species should have been in the 8th part (*JBNHS 70,* 1973), but due to uncertainty of its identity, it was delayed.

Herminium duthiei Hk. f. Ic. Pl. 2199A et Fl. Brit. Ind. 6:130, 1890; Duthie, 199, t. 147, 1906. (Fig. 8).

Plants 7-17 cm high, leaves two or three from below the middle of the stem, linear or oblanceolate. Spike 5-10 cm, many flowered, flowers deflexed, waxy white or pale yellow; floral bracts much shorter than the curved ovary, lateral sepals smaller and subfalcate, dorsal sepal broadly oblong; petals ovate lanceolate, fleshy. Lip as long as the sepals, triangular, entire with a small globose spur, upper surface with two callii near the base. Flowering during July and August. Collected from Junbesa to Taksindu, *c* 2440 m, Thyangboche to Phereche, *c* 4270 m.

Duthie included this species amongst the twenty-four species "not at present known to occur outside the area of the western Himalaya". We have had the opportunity of examining some of the recently collected material, and we find the species has been collected from West Nepal—Polunin, Sykes & Williams—4421 from South of Jumla at 3500 m is very robust, some 13 cm high; P.S. & W—2328 from Jangla Bhangyang at 3960 m is about 10 cm in height, while P.S. & W—1151 from Tukuche at 3700 m is just 6 cm in height. Our materials collected from Junbese to Taksindu as well as from Thyangboche-Phereche area are 7-8 cm in height and they match with P.S. & W—1151 and also with King's material collected from Gharwal. The field notes of the three collections made by Polunin, Sykes & Williams give the colour of the flowers as white, while our Junbesa-Taksindu material had waxy white flowers and the Thyangboche-Phereche material had pale yellow flowers. Our materials have been collected further east.

This species should have appeared in the 9th part (*JBNHS 72,* 1975) but due to delay in the determination, it was held back. After the correct identity of the material as one of the *Herminia,* addition in the key to the species of *Herminium* has to be made to accommodate the species, thus—

ccc Sides of lip not dilated, lip as long as sepals; flowers *c.* 4 mm in diam., waxy white or pale yellow .... *duthiei*

Epilogue

Orchids from Nepal have been listed since 1825, and due to the continuous change in taxonomy of orchid species and discovery and also record of new species which has been going on all the time, it is quite difficult to state the exact number of genera and species that are present in the Nepal flora. At the present time, it would appear from published records that there are 57 orchid genera found in Nepal of which 27 are terrestrial and the remainder (30) being epiphytes with a few lithophytes. The genera which have the largest number of species are *Dendrobium* with 22 species, *Habenaria* with 20 and *Bulbophyllum* with 16 species; and those that have only one species are many—*Agrostophyllum, Anthogonium, Arundinia, Chrysoglossum, Cremastra, Doritis, Ephemerantha, Egigenium, Esmeralda, Hemipilia, Herpysma, Luisia, Ornithochilus, Panisea, Pachystoma, Rhynchostylis, Satyrium, Spathoglottis, Spiranthes, Sunipia,* and *Thunia.* There are some genera, the presence of which in Nepal is given in Landon's Nepal only (1928, London); they being *Ascocentrum* Schltr., *Ceratostylis* Bl., *Diplomeria* Don, *Eulopia* R. Br., *Monomeria* Lindl., and *Podochilus* Bl.

Out of the species that we have ourselves collected (168) and have accounted in the present series, we attach special significance

to the following.

Anoectochilus crispus Lindl. This has been known from Sikkim and Khasia. Our material has been collected from 27° 40′N, 85° 25′E, thus the westward extension of the species is recorded.

Bulbophyllum polyrhizum Lindl. This species is previously known from Sikkim, Nepal and Dehra Dun. As regards the presence of this species in Nepal no recent work on Nepal flora records it. We regard the species to be exceedingly rare.

Dendrobium pygmaeum Lindl. It is from Sikkim that this species is known. We feel that this species is also exceedingly rare in Nepal, and this is the first record from Nepal.

Goodyera hemsleyana King & Pantl. The species is known from Sikkim. Our collection is from 27° 40′N, 85° 25′E, thus the westward limit is extended.

Herminium duthiei Hk. f. This has been collected from Kumaon-Kali valley, Gori Valley and in recent years from W. Nepal. Our two collections are from 27° 33′N, 86° 32′E and 27° 47′N, 86° 45′E; thus the eastern limit is extended.

Herminium jaffreyanum King & Pantl. This Sikkim plant having been collected by us from 27° 45′N, 86° 00′E has its limit extended westwards.

Hemipilia cordifolia Lindl. Although it is mentioned that the species extends from Western Himalayas to Nepal, we do not know how far eastwards the species extends, as we take 'extends to Nepal' rather a vague expression. However our collection was made at 27°40′N, 85° 25′E.

Nervilia scottii (Reichb. f.) Schltr. This is a species known from Sikkim. Our collection having been made at 27° 45′N, 85° 15′E shows the westwards extension.

Orchis habenarioides King & Pantl. This species extends from Bhutan, Sikkim, Nepal on to Kashmir. Our observations are that the species is rare in Nepal.

Zeuxine goodyeroides Lindl. As our collection is from a locality at 27° 38′N, 85° 45′E, the westward limit is extended, for previously the species was known from Sikkim.

Until the complete orchid flora of Nepal is known it is not possible to give the altitudinal distribution of the species. However the species that occur at 3048 m. (10,000 ft) and above are few, namely *Habenaria urceolate* C.B. Cl. (3,650 m), *Herminium duthiei* Hk. f. (4,270 m), *Herminium jaffreyanum* King & Pantl. (3,200 m), *Orchis chusua* D. Don, (3,048 to 3,700 m), *Orchis habenarioides* King & Pantl. (3,810 m), and *Spathoglottis ixioides* (D. Don) Lindl. (3,810 m).

As regards the flowering time, we find that there are three periods, namely 1) March to May or early June, 2) June to August and 3) September to November. This we attribute principally to change in the atmospheric temperature, and light; of course rainfall or other modes of precipitation also have an effect. Plants that were grown in the Indian Co-operation Mission Garden and Godavari Botanic Garden, Government of Nepal showed remarkable response to temperature, and as such we make bold to make this suggestion. Finally we hope that these papers, inspite of the short-comings, will serve to give impetus for further and deeper study of Orchid flora of Nepal.

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Middle East Lepidoptera, XXXII:

Diagnosis of some eremic tribes of Noctuidae—Quadrifinae, with a discussion of their biogeographical significance[1]

E. P. Wiltshire[2]

(*With a text-figure*)

The Old World North-tropical desert zone is considered in relation to the Noctuid genus-groups which characterise it. A definition of Eremic as applying to genus-groups is given. A survey is made of Noctuidae-Quadrifinae tribes already diagnosed and published, which are found inadequate. Proposals and diagnoses are made for further tribal divisions in the Eremic *Catocalinae* (sensu lato) with details of distribution. What is known of the biological data of these groups is discussed and conclusions from these and from their distribution are suggested regarding the history of the desert zone and the Eremic *Catocalinae*.

Introduction

Deserts are characterised by conditions comparatively inimical to life; insects characteristic of adjacent mesophilous areas are less able to inhabit deserts the further they penetrate. In true desert therefore are found:

(i) temporary immigrants from adjacent areas,

(ii) species characteristic of adjacent areas, resident only in enclaves with un-typical microclimates, e.g. oases; and

(iii) specialised resident forms.

It would require too much space to discuss here what morphological characters might be considered adaptations to desert conditions; the desert specialists here discussed are recognised as such from their distribution.

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The term Eremic is here used with reference to the Old World North Tropical desert zone, which is virtually continuous from west to east, considerably overlapping the Tropic of Cancer in Africa, and reaching the latitude of 50 N in Eastern Asia (see Fig. 1).

Taxonomic relations of Eremic Lepidoptera

Some genera (e.g. the Noctuid-Trifid *Agrotis* Ochs. 1816) contain a minority of species specialised to Eremic conditions; other genera (e.g. the Noctuid-Trifid *Oligia* Hubner 1821) contain none at all; these two types of genus are here termed "Non-Eremic". But others again are mainly or entirely composed of specialised Eremic residents, and these are here termed "Eremic" genera. These terms can similarly apply to higher taxa, e.g. tribes, sub-families, families. While there is no Eremic Noctuid subfamily, there are several Eremic tribes;

but the incompleteness of the tribal system of the Noctuidae-Quadrifinae obscures the fact. The tribe is the taxon intermediate between subfamily and genus authorised by Recommendation 29A of the International Code of Zoological Nomenclature. This article therefore seeks to complete the tribal system of the Noctuidae-Quadrifinae, at least as regards the mainly composed of Eremic specialists one might deduce that the deserts which they inhabit are not ancient; but if there are such genera, and a *fortiori* if there are tribes so composed, great antiquity may be inferred.

(E) following a genus or tribe in the tables or text of this article signifies that it is Eremic; (NE) signifies that it is Non-Eremic. [ ] Bra-

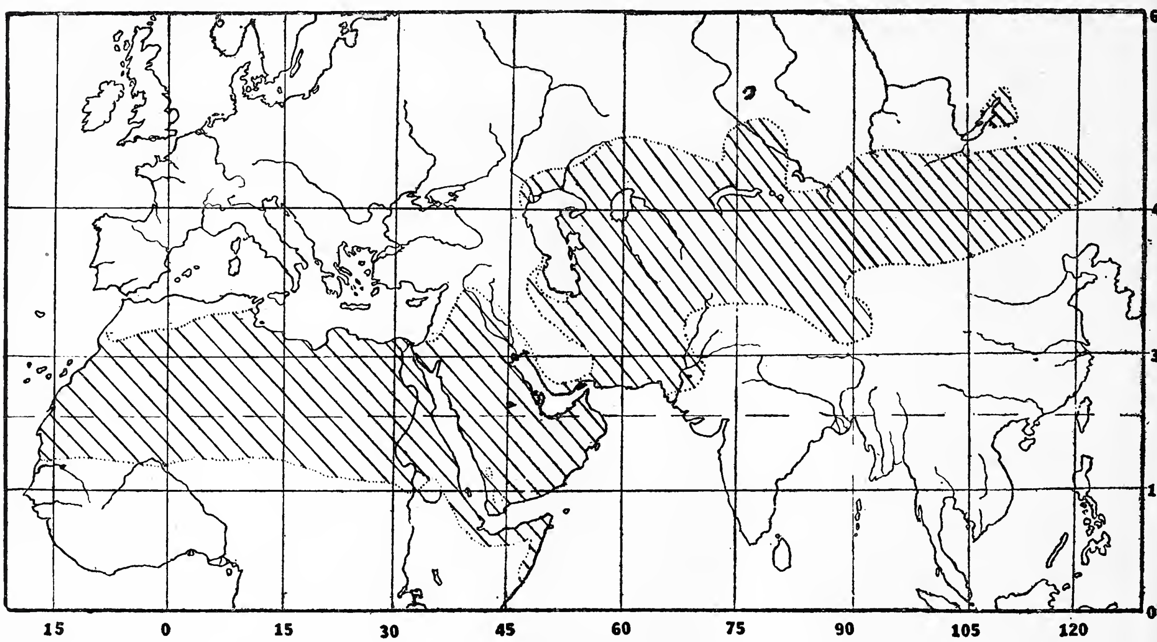

Fig. 1. The Old World North-Tropical Desert Zone: the shaded area is bounded by the 300 mm (11.8") isohyet.

Catocalinae sensu lato (*Catocalinae* and *Othreinae sensu auctorum*). As the existing subfamily system has been considerably criticised (see Berio, 1959 and Birch, 1972), this attempt may contribute to the clarification of supra-generic Noctuid relationships; it may also have biogeographical significance. The higher the rank of taxa sharing the same ecological speciality in an ecofauna, the longer is the associated history which one may attribute to the habitat and its inhabitants. If no genus were ckets are used to indicate a more up-to-date name which it is suggested might be used for a name used by the author of a name of a tribe or sub-family.

Survey of tribes

A system down to tribe and genus not only for the *Noctuidae* but for the whole Lepidoptera was proposed by C. Börner, 1939 & 1944, based particularly on characters of tongue, tympanum, etc. It was however based on a local fauna composed of Non-Eremic genera;

Table 1

Noctuid Quadrifid Tribes as in Börner's system
(Showing genera named by Börner found in Eremic Zone)

HYPENINAE	
Rivulini	(NE) *Rivula* Guenee
Hypenini	(NE) *Hypena* Schranck
HYLOPHILINAE [NYCTEOLINAE]	
Sarrothripini [Nycteolini]	
Hylophilini [Benini]	(NE) *Earias* Hübner
CATOCALINAE	
Catocalini	
Toxocampini [Lygephilini]	(NE) *Autophila* Hübner
Cocytini [Anuini]	(NE) *Ophiusa* Ochs.
SCOLIOPTERYGINAE	
Scoliopterygini	(NE) *Scoliopteryx* Germ.

Table 2

Noctuid Quadrifid Tribes as in Forbes' System
(Showing genera named by Forbes found in Eremic Zone)

ERASTRIINAE	
Eublemmini	(NE) *Eublemma* Hübner
	(NE) *Ozarba* Walker
Erastriini	
Acontiini	(NE) *Acontia* Tr. = *Tarache* Hübn.
EREBINAE [OTHREINAE]	
Synedini [Drasteriini]	(NE) *Drasteria* Hübner
Anomini	(NE) *Anomis* Hübner
Scoliopterygini	(NE) *Scoliopteryx* Germar

in the Noctuidae-Quadrifinae eight tribes were named and diagnosed, summarised in Table 1. C. Börner included the *Jaspidiinae* (=*Erastriinae*) with the Trifid-Noctuidae, and combined the three genera *Erastria* Ochs. (in which he seems to include *Porphyrinia* Hübner, *Jaspidia* Hübner, and *Unca* Oken). *Emmelia* Hübner, and *Acontia* Ochs. in a proposed tribe *Mamestrini* together with such genera as *Mania* Treitschke, *Hydroecia* Guenee, and *Hadena* Schranck. To most students of the Noctuidae, this tribe seems unnatural and too inclusive; one is not surprised therefore that C. Boursin (1947:65-78) summarising Börner's system and praising some of its good points on p. 66 ibidem disassociated himself from its conclusions. C. Boursin was well aware of the unsatisfactory aspects of the Hampsonian system, but he did not find Börner's system, for the Noctuidae, a satisfactory substitute. In particular Börner placed *Autophila* Hübner in the *Toxocampini* whereas Boursin removed it to the neighbourhood of *Pyrois* Hübner in the *Zenobiinae;* on this particular point there may be many who would agree with Börner, and retain the Hampsonian position of *Autophila* and the related genera which Boursin transferred to the Trifid-Noctuidae. Some species of the genera mentioned by Börner in tribes shown in Table 1 may be found here and there on untypical habitats

in the Eremic Zone, but *Autophila* is the only genus containing one or two Eremic species; but not enough to make it an Eremic genus. I propose to replace *Cocytini* Börner by *Anuini* (see Table 3), to avoid confusion with the Sphingid genus *Cocytius* Hübner. Moreover, *Cocytini* Börner contained two genera placed in widely different tribes in Table 3.

Forbes (1954) dealing with a New World fauna proposed a few tribes, only embracing a small part of the Noctuidae-Quadrifinae which he catalogued. He termed his other groupings "series" or "groups", and evidently did not consider them equivalent to tribes. Table 2 summarises Forbes' tribes that are relevant to this article; purely New World Tribes, such as *Erebini*, are omitted. Forbes' treatment of the *Erastriinae* is more traditional than that of Börner, and will probably be preferred since the tribes are smaller and less heterogeneous. They are based mainly on tympanum characters. His name *Synedini* is questionable, and it seems strange that he used it while sinking *Syneda* Guenée to *Drasteria* Hübner. Those of his tribes which are considered here are either Holarctic (e.g. *Synedini*) or Holotropical (e.g. *Anomini*); the former contains a minority of Eremic specialists. Out-

TABLE 3

BERIO'S 1959 SYSTEM OF "PHYLA" AND GENERA, WITH PROPOSED TRIBAL NAMES AND TYPE-GENERA

"Phylum of Cerocala"	(NE) *Drasteriini* nom. nov. for *Synedini* Forbes, 1954.
Type genus: (NE) *Cerocala* Boisd, 1829	
(NE) *Leucanitis* Guenee, 1852	Type genus: *Drasteria* Hubn.
(NE) *Aleucanitis* Warren, 1913	(= *Leucanitis* Guenee plus
(E) *Gnamptonyx* Hampson, 1894[3]	*Aleucanitis* Warren)
"Phylum of Anua"	(NE) *Anuini* nom. nov.
Type genus: (NE) *Anua* Walker.	Type genus: (NE) *Anua* Walker, 1858.
(E) *Clytie* Hübner, 1823[1]	
(NE) *Ophiusa* Ochs.	
and 7 other genera, all NE.	
"Phylum of Scodionyx"	(NE) *Scodionychini* nom. nov.
Type genus: (E) *Scodionyx* Staudinger, 1899	
"Phylum of Pericyma"	(NE) *Pericymatini* nom. nov.
Type genus: (E) *Pericyma* H. Schaeff., 1845.	
(NE) *Heteropalpia* Berio, 1938	
(NE) *Cortyta* Walker, 1857[2]	
(NE) *Tytroca* Wiltshire, 1970	
(E) *Gnamptonyx* Hampson, 1894[3]	
"Phylum of Achaea"	*Achaeini* nom. nov.
Type genus: (NE) *Achaea* Hübner, 1823	
(NE) *Prodotis* John, 1910	
(NE) *Grammodes* Guenee, 1823	
(NE) *Dysgonia* Hübner, 1823	
and five other NE genera.	

[1] with which *Hypoglaucitis* Warren is identical (*syn. nov.*)

[2] *Cortyta* was restricted to its type-species, the S. African *canescens* Walker in Wiltshire, 1970:101.

[3] *Gnamptonyx*, though placed with *Cerocala* by Berio was restored to its usual position, i.e. in the *Pericymatini*, in Wiltshire, 1970:102, for reasons given there.

side these tribes Forbes mentions a few genera containing single species which may penetrate the Eremic zone, e.g. the Holotropical *Tathorhynchus exsiccata* Lederer, related to the genus *Autophila* already mentioned.

Berio, 1959, in a study of the spining of the tibiae of the Old World *Catocalinae* and a few *Othreinae*, grouped certain genera into "Phyla". The International Code of Nomenclature, 1961, makes no recommendation for Phylum-names, and in most systems a Phylum is above the order, is not a genus-group. Therefore except where a prior tribe-name exists I propose that Berio's Phyla (morphologically diagnosed in Berio, 1959) be considered tribes, and the appropriate tribal suffix is shewn in Table 3, in accordance with ICZN Recommendation 29. Berio (personal communication to author, 1974) has agreed to this proposal. Table 3 omits those groups which are entirely non-Eremic, but a few NE genera are included in the table in cases where a few species penetrate the zone to a limited extent, e.g. in enclaves.

Some of the tribes in Tables 1, 2 and 3 will probably require modification, especially considering the different structural criteria used by the three authors, but this must be considered separately. The Eremic genus *Anydrophila* John, 1909, placed by Warren (1913) following *Cortyta* in the *Catocalinae,* was omitted by Berio; its position is discussed below. There is, too, a residue of genera in the *Othreinae* characteristic of the Eremic Zone and requiring tribal distinctions. Only after these definitions will a discussion of the distribution and probable history of the Eremic groups be possible.

Subfamily Catocalinae sensu Hampson
Tribe: *Anydrophilini* nom nov.
Type-genus: *Anydrophila* John, 1909.

This genus hardly fits into the above tribes and I propose that it constitute its own monotypic tribe; at present ten species are known belonging to it—besides the five species in Warren 1913:340 there have been described four more in Brandt 1939, 268-69 and one in Wiltshire, 1947:2.

Characteristics of the genus are: Proboscis, present, strong. Frons, flat or prominent. Male antenna with long bundles of cilia. Mid-tibiae, with one row of scanty spines, other legs spineless; my examination of three Iranian species shows that Warren, 1913:340 is erroneous about the hind-tibiae. The male genitalia resemble generally those of many *Catocaline* genera and would indicate a position between *Clytie* and *Scodionyx*: from *Clytie* they differ in the simpler uncus and symmetrical valves, in these regards resembling *Scodionyx;* in aedeagus form the genus resembles *Clytie* and *Scodionyx;* it differs from *Scodionyx* in habitus, antenna, and fore-leg, also in the uncus-form, and the junction of the valves above and below the aedeagus. Its distribution, from N. Africa to Central Asia, is typically Eremic, with an East Eremic concentration.

Sub-family Othreinae (= *Noctuinae sensu* Hampson)
Tribe: *Anumetini* nom. nov.
Type-genus: *Anumeta* Walker, 1858 (Syn.: *Palpangula* Staudinger)

The tribes' distinguishing characters are: Frons, smooth, flat; ♂ antenna, ciliated; fore-tibia with spines and terminal claws, other legs spineless. ♂ genitalia, symmetrical, with thickened, hairy, thorn-tipped uncus; normal tegumen; simple, elongated valves without processes or harpes, with setose costa and short narrow sacculus, and rounded tip; aedeagus, cylindrical, normal, vesica usually with a bent small chitinous plate; ♀ genitalia, little differentiated, with well-developed ovipositor lobes, weak ostium, usually sclerotised ductus bursae, and large oval bursa copulationis.

The three genera here standing are in fact synonymous; they are: *Anumeta* Walker, 1858, *Imitator* Alpheraky 1882, and *Eremonoma* Warren 1913.

Anumeta is distributed in deserts from N. Africa to India and Mongolia. *Imitator* (syn. n.), known only from the deserts of Central Asia, differs in having brachypterous females; this distinction does not in itself justify generic separation, other genera containing a minority of species with brachypterous females (e.g. *Agrotis* Ochs. see Warren 1913, Plate 5 *c.* "*Euxoa*" *fatidica* Hubn.). *Eremonoma* (syn. n.) found in deserts from N. Africa to the Persian Gulf, differs only in habitus.

Tribe: *Armadini* Wiltshire, 1961.

Type-genus: *Armad*a Staudinger, 1885.

Other genera:

Metoponrhis Staudinger, 1888.

Epharmottomena John, 1909.

Drasteriodes Hampson, 1926.

Riadhia Wiltshire, 1961.

Metopistis Warren, 1913.

Acrobyla Rebel, 1903.

Asplenia Hampson, 1916.

Tarachephia Hampson, 1926.

Forty-one species, including three undescribed, belong to the above nine genera and a tenth undescribed one. A revision of the tribe is in preparation; it is distinguished from its neighbours by the domed or more angular frontal prominence, the very diverse fore-wing habitus, and the short feet with unspined tibiae, with the exception of one species with a small terminal dart on the fore-tibia. The ♂ genitalia are characterised by the normal tegumen, transtilla and juxta; the valves, either symmetrical or larger or more decorated on the left side, opening easily when mounted in ventral position, as in most Trifid genera of the Noctuidae, varying in a series from simple, and sub-oval, to more elongated and sclerotised, with costal and medial-ventral processes as well as harpes; the aedeagus is normal, usually curved dorsoventrally, and sometimes slightly scobinated or otherwise developed distally; cornuti may be absent or numerous, but are never long; and some groups have well developed black pigmented coremata invaginated in the eighth ventrite. The ♀ genitalia have sclerotised antrum and ductus bursae; the bursa copulationis may be sclerotised and rather compressed, or large and membranous, often with a large membranous appendix.

The distribution of these forty-one species is mainly Eremic, with an Eastern Eremic concentration; nearly half the total are Iranian-Turanian and very localised; in three genera there are one widespread Saharan-Sindian species as well as other more local desert species; one monotypic genus (*Asplenia*) extends from Arabia to South Africa; and a few species are found in tropical or temperate steppe mountains on the fringes of the true desert.

The following monotypic Eremic genera are placed near *Anumeta* and *Armada* by Warren 1913; as regards their tribal affinities, they appear *incertae sedis*:-

Genus: *Marsipiophora* John, 1909.

Fits into neither *Anumetini* nor *Armadini;* frons, smooth and flat; fore-tibia with a large terminal claw; habitus of fore-wing recalling *Calophasia;* hind-wing cell with a large black spot; its ♂ genitalia are symmetrical and of general *Armadini* type without agreeing with any *Armadini* genus. Distribution: Iran, Transcaspia (= "Iranian-Turanian"), deserts.

Genus: *Teinoptera* Calberla 1891

This genus and species are a mystery. The type of *T. culminifera* calb. is inaccessible or lost, and the species has apparently never been recaptured since description, despite subsequent visits by lepidopterists to its place of capture (El-Arish desert) (Sinai or near by).

Summary of Catocalinae *sensu lato* of Eremic Zone

The Eremic genera detailed above comprise 101 species belonging to 17 genera and 6 tribes; of the latter, three tribes (*Scodionychini, Anuini, Pericymatini*) are Palaeotropical, and three are Eremic (*Anydrophilini, Anumetini, Armadini*); in addition two monotypic genera (*Marsipiophora* and *Teinoptera*) of uncertain tribal affinity are purely Eremic.

Of the Eremic genera, the two most numerous in species are *Anumeta* (with 24 species, or 21 before the synonymies proposed above) and *Clytie* (with 19 species); four Eremic genera are monotypic: *Scodionyx, Riadhia, Marsipiophora,* and *Teinoptera; Gnamptonyx* and *Metopistis* have only two species, so had *Pericyma* before the combinations proposed in Wiltshire 1970.

In the same sub-family, Catocalinae *sensu lato,* there are, of course, non-Eremic genera containing a minority of Eremic species, and in some of the following the minority is sizeable:- *Heteropalpia, Tytroca, Drasteria* and *Cerocal*a. Three of these could have been classed as Eremic had we included the isolated S.W. African deserts in our definition, as could the monotypic genus *Asplenia.* Other non-Eremic genera with fewer Eremic species are *Thria* Walker, *Acantholipes* Lederer, *Thermesia* Hübner, and *Autophila* Hübner (sec. Boursin, a Trifid); this short list omits genera in which a few species only inhabit oases in the Eremic zone, and none the actual desert.

Discussion

None of the Eremic genera here considered belong to a Palaearctic or Holarctic tribe, as against three belonging to Paleotropical tribes; but before concluding that the Eremic fauna cannot have had Angaran or Cool-temperate origins, it must be recalled that in selecting for treatment in this article only Quardifine Noctuidae we have selected a group more prevalent in the Tropics; an analysis of the Eremic Trifid Noctuidae might well redress the balance, at least to some extent.

Stenophagy (oligophagy) is marked in some groups of Eremic Noctuid genera; but too little is known of the life histories of the majority to permit conclusions to be drawn; probably stenophagy and euryphagy are to be found in similar proportions in the desert fauna as in other Lepidopterous faunae.

Clytie, a very typically Eremic genus, is, as far as is known, monophagous on *Tamarix,* a tree or shrub usually found in oases of the deserts and steppe zones, outside which it is found typically on the coasts of the Temperate Zone: thus the one non-Eremic *Clytie* species, *C. illunaris,* is found on the tamarisks of South France and other Mediterranean countries; but the genus is overwhelmingly Eremic, with East Eremic predominance; it ranges from the extreme west to the extreme East of the desert zone, and very little outside it. The *Anuini* in which Berio placed it however has a majority of Tropical genera.

The bushes and trees of the genus *Acacia* are another food-plant on which Eremic lepidoptera are stenophagous, as discussed for several families in Wiltshire 1949:449-452. In this case the foodplant itself indicates a Paleotropical origin, confirming the evidence provided by co-tribal or congeneric relatives; for the genera *Heteropalpia* and *Tytroca* extend through Tropical Africa into S. Africa; the foot-hold of the *Acacia*-feeding desert-moths is more restricted and southerly than that of *Clytie* in the Eremic zone, as this foodplant does not tolerate the cold of the Central Asian deserts; however, the dwarf leguminous bushes

Prosopis and *Alhagi* provide a substitute for the related genus *Pericyma* which ranges from the East Mediterranean to the Transcaspian deserts and Central Asian steppes; *Gnamptonyx* and *Scodionyx* are two further apparently monophagous genera attached to *Acacia*. *Scodionyx* is placed by Berio in a tribe with the decidedly African genus *Acanthonyx* Hampson of whose biology little is known.

The genus *Cerocala* is also, as far as is known, monophagous on the genus *Helianthemum* (see Wiltshire 1962b for the life-history of *C. sana* Stgr.: the West Mediterranean species *C. scapulosa* Hübn. feeds on *H. halimifolium*, while *C. sana* feeds on the desert dwarf shrubs *H. kahiricum* and *lippii*). This genus is mainly Tropical African and information is lacking of its foodplants there.

Apart from the above and a few other miscellaneous desert moths whose early stages were also described in Wiltshire 1962b, the foodplant of most Eremic lepidoptera is unknown. This particularly applies to the *Anydrophilini*, *Anumetini* and *Armadini*. These tribes have the same distribution-pattern, i.e. Pan-Eremic with an East Eremic or Iranian-Turanian concentration, suggesting that Transcaspia and Iran are the main centres of origin of the Eremic fauna. In the Armadini alone a few Paleotropical species, with comparatively undeveloped morphology, suggest that prior to the great outburst of Eremic specialisation, whether speciation or generic evolution, the tribal ancestors were Afro-Indian ("Gondawanaland"), but as the affinity of some of these primitive forms is perhaps debatable, this is no more than a suggestion; it should be noted however that these Eremic genera and tribes have no links with New World groups at all.

The high taxonomic level of Eremic specialisation in the groups under consideration (going higher than generic level in about fifty per cent of the cases) would indicate a very ancient association of moths with desert habitat: the North Tropical deserts, one can infer, have subsisted, occupying a greater or lesser expanse, over a very long geological period, doubtless over the whole Tertiary and Quaternary periods; the localisation of most of the species, and the comparative fewness of the very widespread species, i.e. those with "Saharan-Sindian" range (e.g. *Acrobyla kneuckeri* Rebel) and "Pan-Eremic" range [e.g. *Armada panaceorum* (Men.)] may be evidence of a previous fragmentation of the desert zone caused by pluvial or even glacial periods on one or more than one occasion during this long time. The widespread species will thus probably have reached their present westernmost limits (that is the Western Sahara) only after that desert's last pluvial period, whereas the few West Eremic species (e.g. *Metoponrhis rungsi* Luc. and *Anydrophila sabouraudi* Luc.) and the Mediterranean *Clytie illunaris* owe their isolation and independence to earlier speciation, perhaps resulting from a previous pluvial period, and are derived from common Eremic ancestors which migrated westwards from the Asiatic centre of distribution much earlier, during a Tertiary dry period.

SUMMARY

Systematic

In the Noctuidae (Quadrifinae) a few names of tribes were proposed by Borner (1939 & 1944) and Forbes (1954); the "Phyla" of Berio (1959) are in fact tribes and suitably terminated names are proposed for them. Even then, available names do not exist to cover all the Catocalinae (*sensu lato*); three new tribes in this subfamily are therefore diagnosed and proposed:- *Anydrophilini*, *Anu-*

metini, and *Armadini*. The first two are exclusively, the third predominantly Eremic. The Eremic genera *Marsipiophora* John and *Teinoptera* Calberla remain tribally *incertae sedis*.

Zoogeographic

Disregarding non-Eremic genera, which may of course contain Eremic species, the Catocalinae *sensu lato* contain 17 Eremic genera and 101 Eremic species; these fall into six tribes, three of which are Paleo-Tropical, three Eremic. Stenophagy of *Clytie* on *Tamarix*, of *Heteropalpia, Tytroca* and *Gnamptonyx* on *Acacia*, and of *Cerocala* on *Helianthemum*, has been observed: other Eremic genera however may be euryphagous. A very ancient association of moths with desert habitat is deduced from the high taxonomic level of the Eremic specialisation in these Noctuidae. It is suggested that the North Tropical Old-World deserts have subsisted throughout the Tertiary and Quaternary. The most widespread Eremic species probably reached their present Western limits in N.W. Africa after the last Saharan pluvial period, expanding from a S.W. Asian centre; the small West Eremic category may have immigrated from a similar centre earlier, perhaps in the late Tertiary, and have speciated when isolated by pluvial periods. In the subfamily considered the remoter origin for the Eremic groups appears Tropical (Gondwanaland) rather than Temperate (Angaran).

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New Descriptions

A NEW FAMILY OF MASTACEMBELOID FISH FROM INDIA[1]

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The genus *Pillaia* was erected by Yazdani (1972) for a remarkable eel-like fish, *P. indica* Yazdani, from the Khasi Hills (Meghalaya), India. The genus exhibited such a combination of characters that it could be placed in the suborder Mastacembeloidei without assigning it to any known family. Berg (1940) recognised two separate orders Mastacembeliformes and Chaudhuriiformes for the families Mastacembelidae and Chaudhuriidae, respectively. Greenwood *et al.* (1966), on the basis of phylogenetic relationship, grouped these two families under the suborder Mastacembeloidei of the order Perciformes. Mastacembelidae occurs both in Oriental and Ethiopian regions whereas Chaudhuriidae, known by a single species, *Chaudhuria caudata* Annandale, 1918, is so far restricted to Oriental region in the Inlé Lake, Burma, which is about 350 miles (560 km) from the area of occurrence of *Pillaia indica.*

The morphology and anatomy of *P. indica* has been studied by dissecting specimens as well as by examining alizarin preparations. For comparison, alizarin preparations of *Mastacembelus armatus* Lacépède and type specimen of *Chaudhuria caudata* which is the only material of this species available at the Zoological Survey of India, Calcutta, have also been examined. Characters of taxonomic value of *Pillaia,* Mastacembelidae and Chaudhuriidae have been compared in Table in order to show the relationship between them as well as to justify erection of a new family. All the available information on the morphology, osteology and anatomy of Mastacembelidae (*see* Berg 1940; Sufi 1956) and of Chaudhuriidae (*see* Annandale 1918; Annandale & Hora 1923; Mitra & Ghosh 1931; Berg 1940) have also been used for comparison.

The comparison given in Table justify placement of the genus *Pillaia* under the suborder Mastacembeloidei. However, certain emendments in the definition of the suborder become necessary after inclusion of *Pillaia.* They are: presence or absence of free maxilla and presence of small to large and weak to strong premaxilla. *Pillaia* shares characters of both Mastacembelidae and Chaudhuriidae in such a combination (*see* Table) that it is not possible to accommodate it in any one of these families. Therefore, a new family, Pillaiidae, is proposed. It can be distinguished from the other two families by the following key characters:

[1] Accepted June 1976.

A. Free spines present before dorsal and anal fins; scales present.
Caudal united with or narrowly separated from dorsal and anal, having 15 or more branched rays; branchiostegals 6; a well-developed fleshy rostral appendage present .... Mastacembelidae

B. No spines before dorsal and anal fins; scales absent.
1. Caudal united with dorsal and anal, having 8-10 unbranched rays; branchiostegals 6; a very indistinct fleshy rostral process present .... Pillaiidae
2. Caudal separated from dorsal and anal, having 7 unbranched rays; branchiostegals 5; fleshy rostral appendage absent.... ...... Chaudhuriidae

TABLE

COMPARISON OF CHARACTERS OF *Pillaia*, MASTACEMBELIDAE AND CHAUDHURIIDAE

Pillaia	MASTACEMBELIDAE	CHAUDHURIIDAE
1. Body eel-like, sub-cylindrical and elongated.	Body eel-like, compressed and elongated.	Body eel-like, compressed and elongated.
2. Head depressed anteriorly.	Head not depressed anteriorly.	Head not depressed anteriorly.
3. Snout short with a very indistinct fleshy rostral appendage.	Snout elongated with a well-developed fleshy rostral appendage.	Snout short without any trace of fleshy rostral appendage.
4. Mouth non-protractile.	Mouth non-protractile.	Mouth non-protractile.
5. Upper jaw consists of a single large, strong hockey-stick shaped bone bearing teeth. It corresponds to premaxilla of perciform fishes.	Upper jaw consists of two bones *viz.* premaxilla bearing teeth and maxilla toothless as is found in all perciform fishes.	Presence of separate maxilla not known. However, the tooth bearing bone in *Chaudhuria caudata* which Annandale (1918) called as maxillary should correspond strictly to the premaxilla of perciform fishes.
6. Branchiostegal rays 6.	Branchiostegal rays 6.	Branchiostegal rays 5.
7. No scales on body.	Minute scales present on body.	No scales on body.
8. No spines before long dorsal and anal fins.	Spines present before long dorsal and anal fins.	No spines before long dorsal and anal fins.
9. Preopercular with one spine.	Preopercular with or without spines.	No information available.
10. Pelvic girdle and fin absent.	Pelvic girdle and fin absent.	Pelvic girdle and fin absent.
11. Pectoral fin with 7-9 rays.	Pectoral fin with 17-27 rays.	Pectoral fin with 6 rays.
12. Pectoral girdle (Supracleithrum) attached to the vertebral column.	Pectoral girdle (Supracleithrum) attached to the vertebral column.	Pectoral girdle (Supracleithrum) attached to the vertebral column.
13. Cleithrum present.	Cleithrum present.	Cleithrum completely fused with supracleithrum.
14. Post-temporal absent.	Post-temporal (except its lateral line component) absent.	Post-temporal absent.

Pillaia	MASTACEMBELIDAE	CHAUDHURIIDAE
15. Pectoral radials absent.	Pectoral radials present.	Pectoral radials absent.
16. Caudal fin homocercal, short confluent with dorsal and anal.	Caudal fin homocercal, short, either confluent with dorsal and anal or narrowly separated.	Caudal fin homocercal, fairly long, separated from dorsal and anal.
17. Two large hypurals united at their bases, fused with last centrum, bearing 8-10 unbranched rays.	Five to seven hypurals bearing 15 or more branched rays.	Two large hypurals united at their bases, firmly attached to the last centrum, bearing 7 unbranched rays.
18. Skull elongated gradually narrowing forwards.	Skull much elongated gradually narrowing forwards.	Skull elongated, gradually narrowing forwards.
19. Fairly large nasals, separated fully in the middle by a spindle-shaped ethmoid.	Large nasals, separated in the middle line by the narrow upper edge of the ethmoid.	Very large expanded nasals, not separated in the middle by the ethmoid.
20. Infraorbital (pre-orbital) bone large articulating with lateral ethmoid.	Infraorbital (preorbital) bone large, articulating with lateral ethmoid.	No information available.
21. Lateral ethmoid small.	Lateral ethmoid small.	Lateral ethmoid small.
22. Frontals large.	Frontals large.	Frontals large.
23. Parietals separated by supraoccipital.	Parietals separated by supraoccipital.	Parietals separated by supraoccipital.
24. Vomer toothless.	Vomer toothless.	No information available.
25. Palatines narrow flakes of bone movably united to parasphenoid and vomer.	Palatines narrow flakes of bone immovably united to ethmoid, vomer and parasphenoid.	Palatines much larger, joined to the pterosphenoid (alisphenoid) by a long suture.
26. Pterygoid movably united to lateral ethmoid outside the palatine.	Pterygoid movably united to lateral ethmoid outside the palatine.	No information available.
27. Vertebrae 62; 26 precaudal and 36 caudal (counted in two specimens).	Vertebrae 85-96; 37-39 precaudal and 47-48 caudal.	Vertebrae 70 (*see* Annandale 1918).
28. Stomach and intestine with U-shaped bends.	Stomach and intestine with U-shaped bends.	Alimentary canal almost straight.
29. No pyloric caeca.	Two pyloric caeca present.	No pyloric caeca.
30. Largest mature specimen measured 77 mm in total length.	Largest specimens measured 190 to 750 mm in total length.	Largest mature specimen measured 52 mm in total length.

Family Pillaiidae, nov.
(Type: *Pillaia* Yazdani)

Small (37-77 mm) eel-like fish without spines before dorsal and anal fins, which are united with caudal having 8-10 unbranched rays; without scales; lateral line only discernible on head; branchiostegals 6, with a very indistinct fleshy rostral process bearing anterior tubular nostrils. Gill-openings wide, mainly lateral; small pectorals; ventrals absent. Mouth wide, non-protractile, with upper jaw consisting of a single, large, strong bone bearing teeth; a free maxilla absent. Preopercular with one spine; pectoral girdle degenerate: no post-temporal, supracleithrum attached to the vertebral column; cleithrum present; no pectoral radials. Two large hypurals united at their bases and fused with last centrum. Nasals separated in the middle by a rather spindle-shaped ethmoid. Vomer toothless. Lateral ethmoid small; frontals large; parietals separated by supraoccipital. Vertebrae 62, 26 precaudal and 36 caudal. Stomach and intestine with U-shaped bends; pyloric caeca absent.

Distinguished from Chaudhuriidae by the shape of head and body, confluence of median fins, caudal having more than 7 unbranched rays, branchiostegals 6, presence of trace of fleshy rostral process and of separate supracleithrum and cleithrum, nasals widely separated in the middle by ethmoid, presence of U-shaped bends in the stomach and intestine, and smaller number (62) of vertebrae; from Mastacembelidae by the shape of head and body, absence of spines (before dorsal and anal) and scales, caudal having only unbranched rays, two large hypurals fused with last centrum, nasals widely separated in the middle by the ethmoid, absence of pectoral radials, upper jaw consisting of a single bone bearing teeth, absence of a free maxilla, smaller number of vertebrae (62) and absence of pyloric caeca.

Discussion

Pillaiidae shows affinities with both Chaudhuriidae and Mastacembelidae. However, the absence of free maxilla which has so far not been recorded in any perciform fish and evolution of a single stout bone in the upper jaw in Pillaiidae are such characters which cannot be easily ignored while considering its relationship with these families. Unfortunately, we know very little about the upper jaw in Chaudhuriidae. However, the drawing of the upper jaw of *Chaudhuria caudata* (*see* Annandale 1918) shows striking resemblance with the upper jaw bone of *Pillaia indica*. Although Annandale (op. cit.) does not mention about the presence or absence of maxilla in *C. caudata* yet his identification of the tooth bearing upperjaw bone as maxillary clearly suggests that it is the premaxilla rather than maxilla. If this presumption is correct Pillaiidae comes closer to Chauhuriidae rather than Mastacembelidae (*vide* Table).

Berg (1940) remarked that *Chaudhuria* (Chaudhuriidae) is so specialized that it plainly deserves the rank of a special order. While proposing the order Chaudhuriiformes, Berg (op. cit.) appears to have been influenced by the discontinuity of various characters between Mastacembelidae and Chaudhuriidae. However, the discovery of Pillaiidae has filled up this gap and a possible evolution of chaudhuriid type form from mastacembelid stock can be easily visualized. Therefore, it is quite reasonable to group all the three families under a common order or suborder rather than ranking each one as suborder or order. Greenwood *et al.* (1966) appreciated the importance of common characters between Mastacembel-

idae and Chaudhuriidae and rightly placed them under the same suborder (Mastacembeloidei) well before the discovery of Pillaiidae which forms a link between them. The gradual modification of various characters in these families has led to extreme specialization as is evidenced in Chaudhuriidae. Pillaiidae appears to be less specialized than Chaudhuriidae and it seems probable that the latter evolved from a stock resembling Mastacembelidae through stages comparable to Pillaiidae.

Mastacembelidae contains two genera, namely, *Mastacembelus* and *Macrognathus*, the latter being restricted to oriental region only (*see* Sufi 1956). Both Chaudhuriidae and Pillaiidae, with single genus each, are also restricted to Burma and India in the Oriental region. The exclusive occurrence of Chaudhuriidae and Pillaiidae within a restricted area of about 350 miles (560 km) and availability of both the mastacembelid genera in that region suggests that Mastacembelidae perhaps evolved somewhere in the South-Chinese region and subsequently migrated westwards. This is also supported by the distribution of freshwater fishes of India which clearly indicates their South-Chinese origin and their subsequent spread westwards along the Himalayas (*see* Menon 1973).

Acknowledgement

I thank Dr. B. K. Tikader, Deputy Director, Zoological Survey of India, Western Regional Station, Poona, for his kind interest and encouragement during the course of this work.

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A NEW SPECIES OF THE GENUS *PUNTIUS* (HAMILTON) (PISCES: CYPRINIFORMES: CYPRINIDAE) FROM WESTERN INDIA[1]

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(*With a text-figure*)

Introduction

During intensive collection of fishes from in and around Poona, four specimens belonging to the genus *Puntius* were obtained, possessing an osseous serrated dorsal ray and a single pair of barbels. Till now, species with an osseous serrated dorsal ray and a single pair of barbels have not been reported from India. However one species, *P. macrolepidotus* (Cuv. & Val.) has been reported from Burma and Malay Peninsula. But the present species differs from it markedly in many characters. Amongst Indian species it resembles *Puntius ambassis* (Day). Detailed description of the species and characters differentiating it from related species are given here. A list of *Puntius* species known from India with their distribution and names of species synonymised under these species has also been appended to give upto date information regarding the species of this widely distributed genus.

Puntius deccanensis sp. nov.

Material:

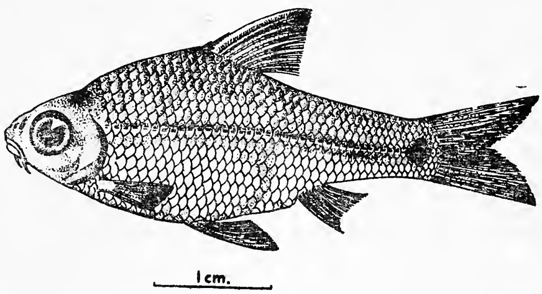
Holotype 48 mm total length (37 mm standard length), Coll. *C. B. Prasad*, dated 20-7-1974. 2 paratypes of 45 mm and 42 mm total length (36 mm and 32 mm standard length respectively), Coll. *C. B. Prasad*, dated 20-7-1974, all from Nalla near Katraj tank. 1 paratype of 36.5 mm total length (27.5 mm standard length), Coll. *B. K. Tikader*, dated 13-2-1976 from Katraj tank.

Description:

Body laterally compressed. Dorsal and ventral profiles convex. Head dorsoventrally compressed, pointing towards the snout. Eyes prominent situated towards the anterior half of head. One pair of maxillary barbels, smaller in length than eye diameter. Nasal pore prominent with a septum. Third dorsal ray robust, osseous and serrated but the serrated edge is covered by a thin layer of skin. Pectorals originate just behind opercular margin, but do not reach ventral origin. Origin of ventrals and dorsal from the same vertical line. Anal originates behind dorsal. Caudal emarginate. Along the lateral line, especially in the posterior half of the body a distinct longitudinal swelling is present in the form of a line, especially in bigger specimens. Lateral line complete. Dorsal half of head dark in colour. A diffuse dark brownish lateral band is present. Dorsally, pigmented dark brown, from the snout to the caudal fin, including the osseous dorsal ray. Pigmentation becoming lighter laterally and the central half of body more or less without pigmentation. A group of jet black spots are present on the caudal peduncle, laterally, near the origin of the caudal fin. Black coloration of the anterior region of the dorsal base. Otherwise fins colourless.

[1] Accepted June 1976.

Meristic counts and body measurements as percentages in standard length for the holotype and paratype (ranges for paratypes in parentheses):



Text-fig. 1. *Puntius deccanensis* sp. nov.

P. 11 (11-13); V. 9(9); D. iii + 9 (iii + 9); A. ii + 7 (ii + 7); C. + 19 + (+19+); L. 1. 44 (42-44).

In percentages of standard length; body depth 34.6 (30.2-34.7); head length 24.9 (25.6-26.3); eye diameter 9.5 (8.4-10-2); snout 7.0 (6.9-7.3); inter-orbital distance 9.5 (8.4-9.7); prepectoral distance 23.0 (23.6-26.5); preventral distance 47.3 (46.9-49.2); predorsal distance 49.2 (48.4-51.6); preanal distance 64.1 (62.5-67.3); pectoral fin length 18.9 (18.2-19.4); ventral fin length 18.4 (18.6-20.3); dorsal base 14.9 (12.7-15.3); anal base 8.1 (9.1-11.9).

Type-locality: Nalla near Katraj Tank, 13 km south of Poona, Maharashtra.

The type material will be deposited in due course with the National Collections of Zoological Survey of India, Calcutta.

The name *P. deccanensis* is given to this species since it was first discovered from Deccan plateau (Poona district).

Discussion

The only other *Puntius* species with serrated last undivided dorsal ray and a single pair of barbels is *P. macrolepidotus* from Burma and Malaya. However, there are more differences between the two species than resemblances. Externally, the body shape is very different, in *P. deccanensis* the body is markedly deeper than in *P. macrolepidotus*, eye bigger, snout shorter and less pointed, scales smaller in the former species when compared with the latter. Further, the two species differ significantly in the number of lateral line scales (42-44 in *P. deccanensis*, 26 in *P. macrolepidotus*), pectoral fin rays (11-13 in *P. deccanensis*, 17 in *P. macrolepidotus*) and anal fin rays (9 in *P. deccanensis*, 7 in *P. macrolepidotus*). Besides, the last undivided dorsal ray is robust and spiny in *P. deccanensis* whereas in *P. macrolepidotus* it is weak ("scarcely osseous", Day 1878).

In view of the fact that the number of barbels is not a very consistent character in this genus, if this character is ignored for a moment, *P. deccanensis* externally comes nearest to *P. ambassis*. However, the two species differ from each other in lateral line (complete in *P. deccanensis*, incomplete in *P. ambassis*), number of lateral line scales (42-44 in *P. deccanensis*, 36 in *P. ambassis*), dorsal fin rays (iii + 9 in *P. deccanensis*, iii + 8 in *P. ambassis*) and anal fin rays (ii + 7 in *P. deccanensis*, ii + 5 in *P. ambassis*).

The *Puntius* spp. occurring in India, along with their distribution and synonyms have been tabulated (Table) for ready reference. Relevant information regarding these has been obtained from works of Day (1878, 1889), Hora (1937, 1941), Misra (1961), Menon (1963, 1974), Kulkarni & Ranade (1974) etc.

Acknowledgements

We are thankful to Dr. B. K. Tikader, Deputy Director, Zoological Survey of India, Western Regional Station, Poona, for his kind interest and encouragement during the course of this investigation.

TABLE

DISTRIBUTIONAL LIST OF INDIAN SPECIES OF *Puntius*

Name of species	Important synonyms	Range of distribution
A. *With undivided dorsal ray serrated*		
1. *Puntius clevatus* (McClell.)	—	India: East Himalayan drainages.
2. *Puntius sarana* (Ham.)	*Barbus chrysopoma* Day *B. pinnauratus* Day	India, Pakistan, Bangladesh, Burma, Sri Lanka, Thailand & China.
3. *Puntius pleurotaenia* (Bleeker)	—	India: Karnataka; Sri Lanka.
4. *Puntius roseipinnis* (C.V.)	—	India: Pondicherry.
5. *Puntius deccanensis* sp. nov.	—	India: Poona (Maharashtra).
6. *Puntius ambassis* (Day)	—	India: Tamil Nadu, Orissa, W. Bengal, Assam and Maharashtra.
7. *Puntius conchonius* (Ham.)	—	India, Pakistan and Bangladesh.
8. *Puntius ticto* (Ham.)	*Barbus punctatus* Day *B. stoliczkanus* Day	India; Pakistan, Bangladesh, Burma, Sri Lanka and Thailand.
9. *Puntius gelius* (Ham.)	—	India; Bihar, Orissa, West Bengal, Maharashtra, U.P., Assam; Bangladesh.
10. *Puntius phutunio* (Ham.)	—	India: Orissa, West Bengal, Assam; Bangladesh and Burma.
11. *Puntius shalynius* Yazdani & Talukdar	—	India: Khasi and Jaintia Hills (Meghalaya).
12. *Puntius guganio* (Ham.)	—	India: Gangetic provinces and Assam.
B. *With undivided dorsal ray non-serrated*		
13. *Puntius dubius* (Day)	—	India: Tamil Nadu and Karnataka.
14. *Puntius micropogon* (C.V.)	—	India: Karnataka, Tamil Nadu and Kerala.
15. *Puntius chilinoides* (McClell.)	—	India: Himalayan drainage.
16. *Puntius carnaticus* (Jerdon)	—	India: Karnataka, Kerala and Tamil Nadu.
17. *Puntius bovanicus* (Day)	—	India: Tamil Nadu.

Name of species	Important synonyms	Range of distribution
18. *Puntius sophore* (Ham.)	*Barbus chrysopterus* (McClell.) *B. stigma* (Val.) Day *B. carletoni* Fowler *B. annandalei* Fowler	India; Pakistan, Nepal, Bangladesh, Burma and Yunnan.
19. *Puntius curmuca* (Ham.)	——	India: Western ghats, Kerala.
20. *Puntius lithopides* (Day)	——	India: Karnataka and Kerala.
21. *Puntius thomassi* (Day)	——	India: Karnataka.
22. *Puntius spinolosus* (McClell.)	——	India: Sikkim.
23. *Puntius jerdoni* (Day)	*Barbus pulchellus* Day *Barbus dobsonii* Day	Peninsular India.
24. *Puntius wynaadensis* (Day)	——	India: Wynaad, Maharashtra.
25. *Puntius neilli* (Day)	——	India: Karnataka and Deccan.
26. *Puntius malabaricus* (Jerdon)	——	India: Karnataka and Western Ghats.
27. *Puntius melanampyx* (Day)	——	Peninsular India.
28. *Puntius chola* (Ham.)	*Systomus tetrarupagus* (McClell.) *Cyprinus titius* (Ham.)	India; Sri Lanka, Pakistan, Bangladesh and Burma.
29. *Puntius parrah* (Day)	——	Peninsular India.
30. *Puntius dorsalis* (Jerdon)	*Barbus puckelli* Day	Peninsular India, Sri Lanka.
31. *Puntius kolus* (Sykes)	——	India: Peninsular and Central part.
32. *Puntius denisonii* (Day)	——	India: Kerala.
33. *Puntius melanostigma* (Day)	——	India: Karnataka, Kerala and Tamil Nadu.
34. *Puntius arenatus* (Day)	——	Peninsular India.
35. *Puntius amphibia* (Val.)	——	Peninsular India, Sri Lanka.
36. *Puntius arulius* (Jerdon)	——	Peninsular India.
37. *Puntius filamentosus* (C.V.)	*Barbus mahecola* (C.V.)	Peninsular India; Sri Lanka.
38. *Puntius terio* (Ham.)	——	India: Assam, West Bengal, Punjab, Orissa; Bangladesh.
39. *Puntius punjabensis* (Day)	——	India: Jabalpur; Pakistan, Ravi drainage at Lahore, Sind.
40. *Puntius waageni* (Day)	——	Indus drainage (India & Pakistan).
41. *Puntius cosuatis* (Ham.)	——	India: Along the Himalayas and Western Ghats.
42. *Puntius vittatus* (Day)	——	India: Gujarat, Peninsular India; Sri Lanka.
43. *Puntius puntio* (Ham.)	——	India: W. Bengal; Burma.
44. *Puntius sahyadriensis* Silas	——	India: Maharashtra.
45. *Puntius narayani* Hora	——	India: Karnataka.
46. *Puntius cauveriensis* Hora	——	India: Karnataka.

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TWO NEW SPECIES OF SPIDERS OF THE GENERA *CHEIRACANTHIUM* KOCH AND *CLUBIONA* LATREILLE (FAMILY: CLUBIONIDAE) FROM INDIA[1]

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(*With eight text-figures*)

The spiders of the family Clubionidae are very little known in India. I have described previously (1962) a single species of the genus *Cheiracanthium;* subsequently Patel & Patel (1973) described a second species and very recently (1975) I have described the third species of this genus from India. The spiders of the genus *Clubiona* are practically unknown in the Indian fauna. Recently Patel & Patel (1973) described a single species of the genus *Clubiona* from Gujarat.

While examining the spider collection received from Dr. G. L. Sadana, Punjab Agricultural University, Ludhiana, Punjab, I came across two new species belonging one each to the genera *Cheiracanthium* and *Clubiona* which are described here.

All the type specimens will in due course be deposited in the National Collections of Zoological Survey of India, Calcutta.

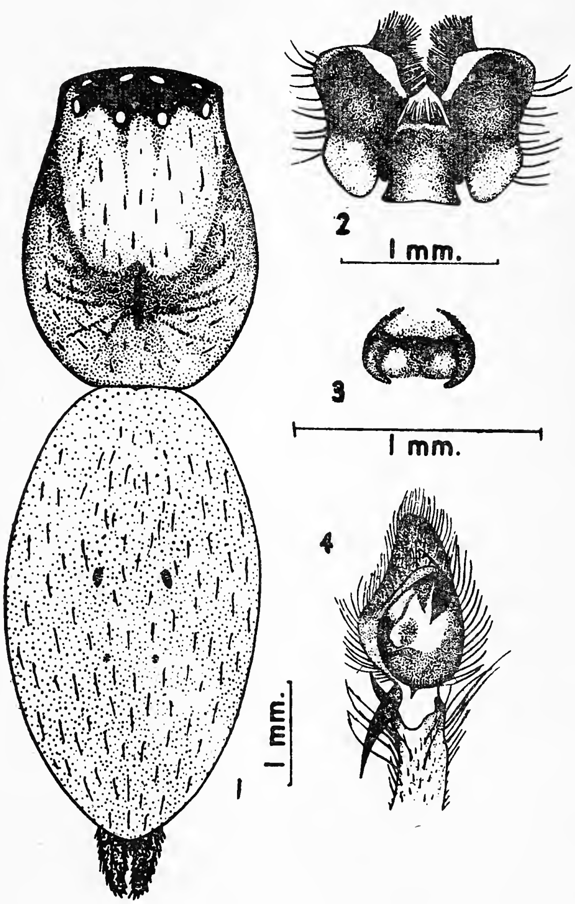
Cheiracanthium sadanai sp. nov.[2]

General: Cephalothorax, abdomen and legs light green. Total length 8.00 mm. Cephalothorax 3.20 mm long, 2.30 mm wide; abdomen 4.80 mm long, 2.50 mm wide.

[1] Accepted February 1976.

[2] It is with much pleasure that I have named this species after Dr. G. L. Sadana, Agricultural University, Ludhiana, who collected this specimen for my study.

Cephalothorax: Longer than wide, wider in front, clothed with fine hair and a few spine-like hairs, moderately convex, cephalic region slightly higher than posterior region. Eyes pearly white, anterior row slightly recurved and posterior row procurved; lateral eyes nearly contiguous; medians nearly oval and white, slightly larger than laterals. Ocular quad longer than wide and slightly wider behind than in front. Middle of cephalothorax provided with a fovea. Chelicerae strong, nearly vertical and dark brown in colour, provided with inner scopulae, inner margin provided with two small teeth but outer margin with one tooth large and another one very small. Maxillae and labium as in text-fig. 2 provided with deep brown colour. Sternum heart-shaped, pointed behind, clothed with fine hairs. Legs long, clothed with hairs and spines. Anterior legs longer than posterior. Male palp as in text-fig. 4.



Figs. 1-4. *Cheiracanthium sadanai* sp. nov. 1. Dorsal view of female, legs omitted; 2. Maxillae and labium; 3. Epigyne; 4. Right male palp, ventral view.

Abdomen: Rather long, narrowed posteriorly, clothed with pubescence and some long hairs. Ventral side uniform pale coloured. Epigyne as in text-fig. 3.

Holotype female, *allotype* one male in spirit.

Type-locality: Ludhiana Agricultural University compound, Punjab, India. Coll. *Dr. G. L. Sadana,* 12-xi-1975.

This species resembles *Cheiracanthium danieli* Tikader, but it can be distinguished as follows: (i) Abdomen dorsally pale-greenish in colour but in *C. danieli* abdomen dorsally brownish-green. (ii) Epigyne and male palp structurally different.

Clubiona ludhianaensis sp. nov.

General: Cephalothorax and legs brownish green, abdomen pale-green. Total length 11.00 mm. Cephalothorax 4.20 mm long, 3.00 mm wide; abdomen 6.80 mm long, 3.60 mm wide.

Cephalothorax: Longer than wide, wider in front, clothed with fine hair and some spine-like hairs; convex, cephalic region slightly higher than posterior region. Eyes pearly white, posterior row longer and slightly procurved; anterior row nearly straight. Ocular quad wider than long and wider in behind, all eyes nearly of same size. Middle of cephalothorax provided with prominent fovea. Chelicerae strong, nearly vertical and dark brown in colour, inner margin provided with two equal size teeth and outer margin with three teeth but middle one larger than other two teeth. Maxillae and labi-

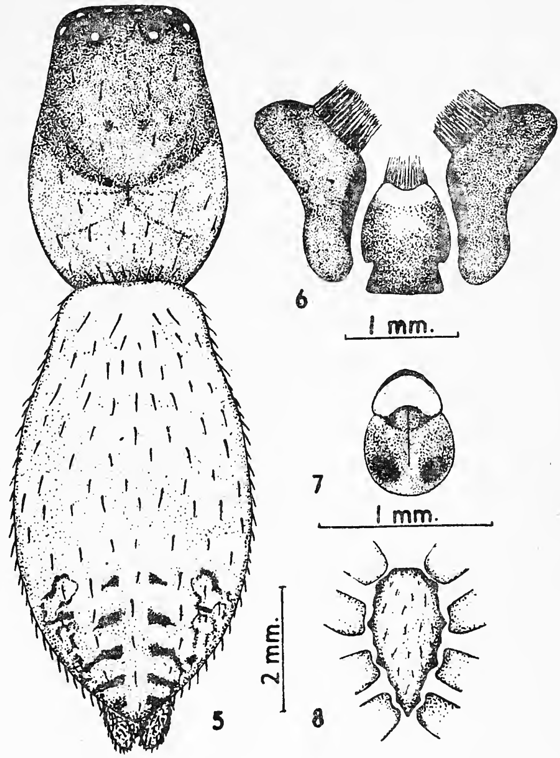
um as in text-fig. 6, provided with deep brown colour and anterior end of maxillae provided with conspicuous scopulae. Sternum nearly heart-shaped, longer than wide, clothed with fine hairs; border just opposite of coxa of legs provided with conspicuous dark brown marks as in text-fig. 8. Legs long, stout, clothed with hairs. Posterior legs longer than anterior legs. Tibiae of I and II provided with two pairs of ventral spines and metatarsi and tarsi also provided ventrally with scopulae.

Abdomen: Longer than wide, narrowed posteriorly, clothed with pubescence. Posterior half of abdomen provided with brown markings as in text-fig. 5. Ventral side uniform pale colour. Epigyne as in text-fig. 7.

Holotype female, *paratype* one female in spirit.

Type-locality: Ludhiana, Punjab Agricultural University compound, Punjab, India. Coll. *Dr. G. L. Sadana,* 10-xi-1975.

This species resembles *Clubiona pashabhaii* Patel & Patel but it can be distinguished as follows: (i) Posterior half of abdomen provided with brown markings but in *C. pashabbaii* abdomen provided with three rows of longitudinal deep brown dots. (ii) Epigyne structurally different.



Figs. 5-8. *Clubiona ludhianaensis* sp. nov.
5. Dorsal view of female, legs omitted; 6. Maxillae and labium; 7. Epigyne; 8. Sternum of female.

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A NEW SPECIES OF SPIDER OF THE GENUS *PLATOR* SIMON (FAMILY—PLATORIDAE) FROM ALMORA, INDIA[1]

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(*With three text-figures*)

The spiders of the family Platoridae are little known from India. The first species of the genus *Plator* was described from India by Simon (1897) and the second species by Tikader (1969) and subsequently a third species was recently described by Tikader & Gajbe (1973).

While examining the spider collection from Northern Regional Station, Zoological Survey of India, Dehra Dun, U.P. India, we came across a new species of the genus *Plator*, which is described here. It is the fourth species of the genus *Plator* from India.

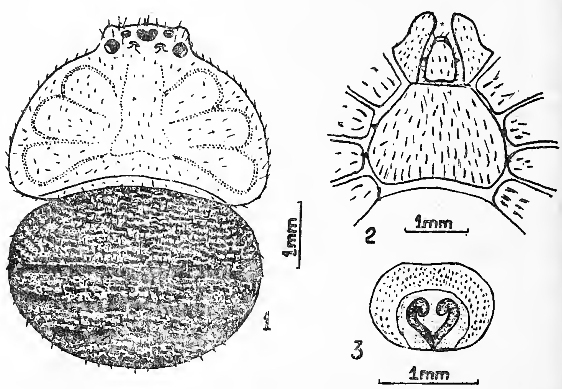
We are thankful to Dr. B. S. Lamba, Deputy Director, Zoological Survey of India, Northern Regional Station, Dehra Dun for supplying the spiders for our study.

The type specimen will in due course be deposited in the National Collections, Zoological Survey of India, Calcutta.

Plator himalayaensis sp. nov.

General: Cephalothorax and legs reddish brown, abdomen deep brown. Total length 5.10 mm. Carapace 2.50 mm long, 3.90 mm wide; abdomen 2.70 mm long, 3.80 mm wide.

Cephalothorax: Very flat, leaf-like, much wider than long, cephalic region narrow and flat, clothed with black spine-like hairs. Eyes eight, in two rows, posterior row slightly recurved but anterior row straight. Posterior lateral eyes larger and black but posterior medians smaller, white and crescent shaped; base of eyes encircled by black patch except posterior median eyes. Mandibles weakly armed, labium longer than wide as in text-fig. 2. Sternum wider than long, slightly narrow in front, clothed with fine hairs. Legs long and strong, clothed with hairs and spines. Legs I shorter than the rest, II longest, anterior two legs armed with conspicuous erect spiniform bristles. Tarsus without scopulae or ungual tufts.



Figs. 1-3. *Plator himalayaensis* sp. nov.
1. Dorsal view of female, legs omitted; 2. Maxillae and labium of female; 3. Epigyne.

Abdomen: Very flat, leaf-like, nearly rounded posteriorly, wider than long, slightly overlapping on the cephalothorax in front, clothed with fine hairs. Dorsally provided with irregular minute markings of muscular corrugation and three transverse muscular depressions as in

[1] Accepted March 1975.

text-fig. 1. Ventral side more lighter than dorsal side and clothed with fine hairs. Epigyne as in text-fig. 3.

Holotype: One female in spirit (legs broken).

Type-locality: Bageshwar, Dist. Almora, U.P., India. *Coll. J. C. Tripathi*, 30-vi-1972.

This species is closely related to *Plator kashmirensis* Tikader & Gajbe. However, *Plator himalayaensis* differs from *P. kashmirensis* in the structure of female epigyne. Abdomen dorsally provided with transverse depression and absence of sagilla, but in *P. kashmirensis* abdomen dorsally provided with two longitudinal rows of sagilla.

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NEW SPECIES OF THE GENUS *NEOAENASIOIDEA* AGARWAL (HYMENOPTERA: ENCYRTIDAE))[1]

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(*With fourteen figures in a plate*)

An account is given of the known species of the genus *Neoaenasioidea* Agarwal. *Neoaenasioidea albiscutellaris* sp. nov. is described in detail. The species *N. indica* Agarwal, *N. nigritus* Agarwal and *N. albiclavatus* Agarwal are also briefly described.

Genus *Neoaenasioidea* Agarwal

Neoaenasioidea Agarwal, 1966, *Proc. Indian Acad. Sci.*, 63:71. Type species, *Neoaenasioidea indica* Agarwal (Monobasic).

The distinguishing characters of this genus have been given in detail by Agarwal (1966). It is more closely related to *Homalotylus* Mayr, but differs from it in having first valvifer with basal and apical angles in one plane (figs. 7-9), second valvifer long and more or less of uniform width, third valvulae long and movably articulated with second valvifers (figs. 12-14). Recently Agarwal (1970) described two new species *N. albiclavatus* and *N. nigritus*. In the present study a new species *N. albiscutellaris* is described thereby making a total of four species of the genus *Neoaenasioidea* Agarwal.

[1] Accepted May 1975.

Neoaenasioidea albiscutellaris sp. nov.
(Figs. 1-4, 9, 13)

FEMALE

Head: Dark, facial region yellow; fronto-vertex narrow; ocelli red, arranged in acute triangle, lateral ocelli very close to orbit and removed from occipital margin by less than their diameter; malar space shorter than eye width; antennae inserted near the oral margin; mandibles tridentate (fig. 1); maxillary and labial palpi 4 and 3-segmented respectively (fig. 2).

Antennae (fig. 3).—Dark, distal funicle segment and club white; scape cylindrical, slightly more than six times longer than wide; pedicel distinctly longer than first funicle segment; funicle segments 1-6 subequal in length and gradually increasing in width distal; club three segmented, two and a half times longer than wide, slightly longer than preceding three funicle segments combined.

Thorax: Infuscated, lateral sides of pronotum and scutellum yellow; pronotum with anterior margin slightly concave, posterior margin more or less straight (fig. 4); mesoscutum with well developed parapsidal furrows.

Fore wings: Hyaline, a broad infuscated patch in the middle, three times longer than wide; submarginal vein long; marginal vein short, about as long as wide; stigmal vein distinctly longer than postmarginal vein; marginal fringe short, spaced by a distance equal to one-third their length.

Hind wings: Hyaline, more than four times longer than wide; marginal fringe short spaced by a distance equal to one-third their length.

Fore legs: Dark brown.

Middle legs: Yellow, basal two-third of tibiae dark-brown; middle tibial spur longer than basitarsus.

Hind legs: Dark, basal four tarsal segments white.

Abdomen: Dark, slightly longer than thorax; ovipositor much exserted; first valvifer semicircular, the basal and apical angles in one plane (fig. 9); second valvifer long and more or less of uniform width; third valvulae long and movably articulated with second valvifers (fig. 13).

Length of female excluding exserted part of ovipositor: 2.02 mm.

Holotype ♀, 1♀ paratype, India, Uttar Pradesh, Aligarh, ex Aphids on *Solanum* sp., 27-ix-1974 (*M. Younus Khan*). Material in Zoological Museum, Aligarh Muslim University, Aligarh, India.

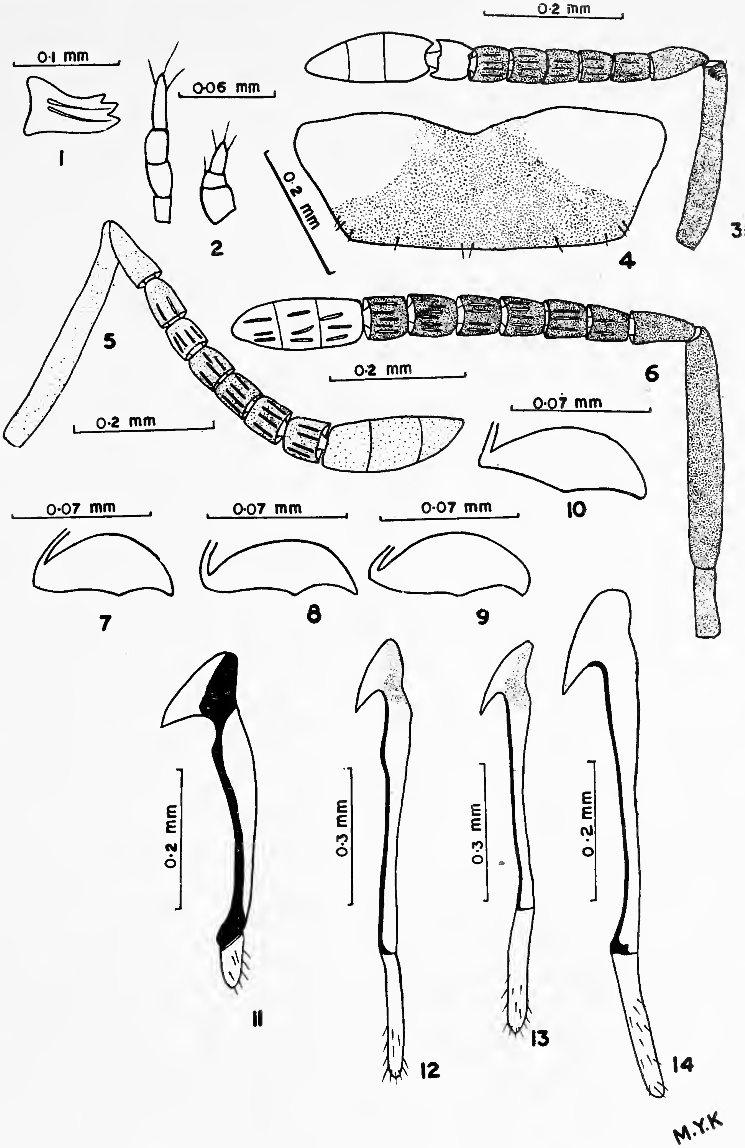
Neoaenasioidea indica Agarwal
(Figs. 5, 7, 12)

FEMALE

Head: Yellowish; malar space longer than eye width; antennae yellowish brown, club white; scape slightly more than eight times longer than wide; pedicel slightly shorter than basal two funicle segments combined; club longer than preceding three funicle segments combined. Thorax yellow, scutum dark slightly metallic sheen; fore wings slightly more than two and a half times longer than wide; stigmal vein twice as long as postmarginal vein; fore legs yellow; middle legs yellow, basal portions of tibiae brownish; hind legs brown, coxae trochanters apical portions of femora and tarsal segments yellow. Abdomen yellow, tergites brownish yellow.

Length of female excluding exserted part of ovipositor: 1.9 mm.

Material examined: 4♀, India, Uttar Pradesh, Aligarh, ex Mealy bug on *Solanum* sp., 9-ix-1974 (*M. Younus Khan*). Material in Zoological Museum, Aligarh Muslim University, Aligarh, India.



Figs. 1-4, 9, 13. *Neoaenasioidea albiscutellaris* sp. nov. ♀. (1) Mandible; (2) Maxillary and Labial palpi; (3) Antenna; (4) Pronotum; (9) First valvifer; (13) Second valvifer and third valvulae; Figs. 5, 7, 12. *Neoaenasioidea indica* Agarwal, ♀. (5) Antenna; (7) First valvifer; (12) Second valvifer and third valvulae; Figs. 6, 8, 14. *Neoaenasioidea nigritus* Agarwal, ♀. (6) Antenna; (8) First valvifer; (14) Second valvifer and third valvulae; Figs. 10, 11. *Homalotylus flaminius* (Dalmen), ♀. (10) First valvifer; (11) Second valvifer and third valvulae.

Neoaenasioidea nigritus Agarwal
(Figs. 6, 8, 14)

FEMALE

Head: Dark brown; antennae dark brown, club white; scape about seven times as long as wide; club more than two and a half times longer than wide, as long as preceding three funicle segments combined. Thorax dark brown; fore wings more than two times longer than wide; stigmal vein one and a half times longer than postmarginal vein; marginal fringe spaced by a distance equal to one-fourth their length; legs dark brown; mid and hind tarsal segments and middle tibial spur white; middle tibial spur shorter than basitarsus. Abdomen dark brown, about as long as thorax.

Length of female excluding exserted part of ovipositor: 1.6 mm.

Material examined: 5 ♀, India, Uttar Pradesh, Aligarh, ex Mealy bug on *Solanum* sp., 9-ix-1974 (*M. Younus Khan*). Material in Zoological Museum, Aligarh Muslim University, Aligarh, India.

Neoaenasioidea albiclavatus Agarwal

FEMALE

Head: Yellowish; antennae with funicle segments 1-5 dark brown, 6th and club white. Thorax yellow, scutum slightly metallic sheen; fore legs light brown, tibiae and tarsi brownish; hind legs brownish, tarsal segments 1-4 white.

Length of female excluding exserted part of ovipositor: 1.8 mm.

Material examined: 2 ♀, India, Uttar Pradesh, Aligarh, ex *Pseudococcus* sp. on *Citrus medica*. Material in Zoological Museum, Aligarh Muslim University, Aligarh, India.

ACKNOWLEDGEMENTS

I am greatly indebted to Dr. S. Adam Shafee, Department of Zoology, Aligarh Muslim University, Aligarh, for his guidance and supervision. I am thankful to Prof. S. Mashhood Alam, Head, Department of Zoology, for providing research facilities and to Prof. Nawab H. Khan for encouragement. Thanks are also due to Dr. Man Mohan Agarwal for his valuable suggestions.

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A NEW SPECIES OF THE *MEDIORHYNCHUS* (ACANTHOCEPHALA: GIGANTORHYNCHIDAE) FROM THE GREAT INDIAN BUSTARD, *CHORIOTIS NIGRICEPS* (VIGORS)[1]

P. D. GUPTA[2]

(*With five text-figures*)

Three immature and one mature males and eight females collected from the intestine of the Great Indian Bustard, *Choriotis nigriceps* (Vigors) caught at Pokaran (Jaisalmer District), Rajasthan, India during August to October, 1970 form the basis of the description given below.

Mediorhynchus rajasthanensis sp. nov.

With characters of the genus. Sexual dimorphism very pronounced. Male somewhat swollen in the anterior region just behind the proboscis and without external segmentation. Mature female shows prominent external segmentation, attaining maximum width slightly behind mid-body. Proboscis receptacle, a double-walled muscular sac. Proboscis armed with 12 spiral rows of four hooks 100-120 μ in length and 16-20 μ in diameter and 30 spiral rows of 14-15 spines 20 μ in length.

MALE: 9.440[3] in length and 0.828 in maximum width. Proboscis 0.966 × 0.540-0.612. Proboscis sheath 0.756-11.080 × 0.396-0.468. A pair of unequal lemnisci, measuring 1.980-2.840 × 0.144, each with 7 nuclei. Almost spherical brain, measuring 0.180, situated towards the posterior end of the proboscis, just in front of its junction with the body. Elliptical testes situated in posterior third of the body length. Anterior testis 0.684- × 0.216, posterior testis 0.648 × 0.216. Cement glands 8 in number, situated just behind the posterior testis. Seminal vesicle 0.648 × 0.126. The right side of the muscular cap of bursa is longer than the left side and measuring 0.306 in length. Bursa 0.306 × 0.180, with maximum width at its anterior end.

FEMALE: 60-75 in length; 2.0-3.5 in width. External segmentation pronounced in middle part of the body whereas anterior part containing lemnisci devoid of external segmenta-

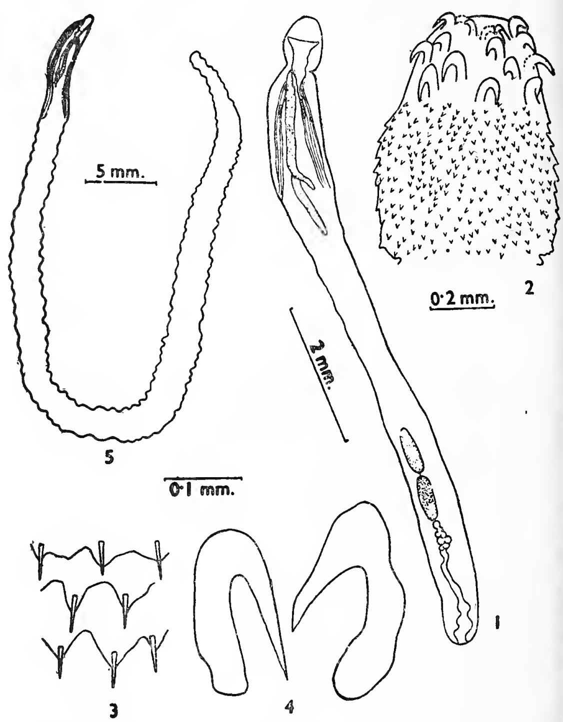

Fig. 1. *Mediorhynchus rajasthanensis* sp. nov., male; Fig. 2. Female; Fig. 3. Proboscis of *M. rajasthanensis;* Fig. 4. Proboscis hooks magnified; Fig. 5. Proboscis spines magnified.

[1] Accepted July 1975.

[2] Western Regional Station, Zoological Survey of India, Poona 411 005.

[3] All measurements in millimetres.

tion. Sometimes the outline may be undulating before becoming completely smooth in the posterior part. Ova 0.062-0.081 × 0.031-0.050.

Discussion

Mediorhynchus rajasthanensis has the least number of proboscis hooks so far reported in the genus. The species is peculiar in its males having smooth body surface whereas the gravid females show marked peudosegmentation. *M. rajasthanensis* resembles most closely *M. grande* (Van Cleave 1916) in the matter of proboscis hooks but has more spines compared to *M. grande*.

HOST: Great Indian Bustard, *Choriotis nigriceps* (Vigors).

LOCATION: Intestine.

TYPE-LOCALITY: Pokaran (Jaisalmer District), Rajasthan. Type specimens to be duly deposited in the National Collection in the Zoological Survey of India, Calcutta.

Acknowledgements

I am greatly obliged to Shri H. C. Gupta, Divisional Forest Officer, Jodhpur and Shri Y. D. Singh, Zoo Supervisor, Jodhpur for providing the opportunity of collecting the parasites and Dr. B. K. Tikader, Deputy Director, Zoological Survey of India, Poona for his kind interest in the work.

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A NEW SPECIES OF CESTODE OF THE GENUS *SCHISTOMETRA* (CESTODA: DAVAINEIDAE: IDIOGENINAE) FROM THE GREAT INDIAN BUSTARD, *CHORIOTIS NIGRICEPS* (VIGORS)[1]

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(*With four text-figures*)

Introduction

Skrjabin (1914), Baer & Fain (1955) and Yamaguti (1959) have maintained the validity of the genus *Schistometra* Cholodkovsky (1912). Yamaguti (1959) transferred *Bertia pinguis* Fuhrmann (1904) to the genus *Ophryocotyloides* Fuhrmann (1920) on the basis of a persistent uterus; and accepted only two valid species of the genus *Schistometra, S. conoides* and *S. macqueeni*. Another species is described here.

During August, 1970 two birds of the host species *Choriotis nigriceps,* were caught by the authorities of the Rajasthan Forest Department but they did not survive in captivity and were

[1] Accepted July 1974.

placed at my disposal for examination and collection of helminth parasites. Both the birds harboured the new species described below. A number of these worms were collected and about a dozen of them were mounted for study.

Schistometra nigriceps sp. nov.

Length of strobila 123-200 mm. Number of proglottids in mature strobila varying from 255-441. The proglottids much broader than long, measuring 0.279-0.409[2] in length and 1.372-4.000 in max. breadth. In no case are the segments longer than broad. Scolex 0.513 × 0.693 (Figs. 1 & 2). Rostellum 0.288 × 0.405 in diameter, armed with a single row of 300-400 hooks each 11 μ in length. Suckers 0.198-0.270 × 0.237-0.252, are provided with tentacles 0.020-0.035.

Testes in a transverse band, with its position varying in posterior half of the proglottid, and occupy the median space between the excretory canals of the two sides. In antero-posterior direction testes arranged mostly in 2-3 tiers, of 15-20 follicles, sometimes fourth tier also discernible. Testes irregularly super-imposed, 60-80 in number and measuring 0.036-0.054 in diameter. Cirrus sac extending mostly beyond ventral excretory canal and measuring 0.180-0.207 × 0.099-0.108. Eversible cirrus, when fully ejected measuring 0.270 in length and 0.054 in maximum width at its base.

Ovary 0.176-0.215 in diameter, on the poral side, between excretory canal and testes. Vagina, 0.027 in diameter, opening into genital atrium in varying position anterior or posterior to the cirrus sac. Uterus tubular or saccular, its transverse extension not properly discernible. In certain segments having early stage of testes, uterus appears to extend about half the width of the segment. In more mature segments the sac like nature of the uterus disappears. Genital duct passes between the two excretory ducts. Genital pores irregularly alternate, situated sub-marginally in the anterior part of segment (Fig. 3).

Vitelline gland lying very close and aporal to the ovary, sometimes appearing crescent shaped (Fig. 4).

Host: *Choriotis nigriceps* (Vigors).

Location: Intestine.

Locality: Pokaran (Jaisalmer district, Rajasthan).

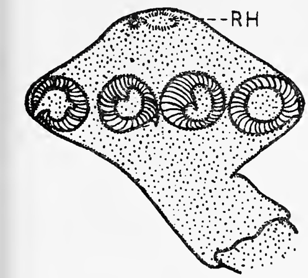
[2] All measurements in millimetres.

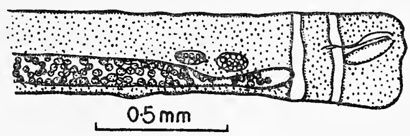
Discussion

Schistometra nigriceps differs from *S. conoides* in having lesser width of proglottids, lesser number of rostellar hooks, smaller number of and shorter size of testes and smaller cirrus sac. *S. nigriceps* further differs from *S. conoides* in the arrangement of rostellar hooks which are arranged in two rows in *S. conoides* (Baer 1955; p. 27) although in the key (p. 40) Baer has mentioned *S. conoides* as having a single row of rostellar hooks. *Schistometra nigriceps* differs from *S. macqueeni* in having lesser number of testes, smaller cirrus sac, a definitely oval or rounded ovary [Woodland (1930) has described transversely elongated ovary] and in the possession of tentacles on the suckers. In addition *Schistometra nigriceps* differs from *S. macqueeni* in the arangement of rostellar hooks which are arranged in a wavy fashion in *S. macqueeni* but in a simple circular row in *S. nigriceps*. The new species differs from *S. pinguis* (= *Ophryocotyloides pinguis*) in possessing greater number of rostellar hooks, absence of a persistent uterus and longer strobila.

ACKNOWLEDGEMENTS

I am greatly obliged to Shri H. C. Gupta, Divisional Forest Officer, Jodhpur and Shri Y. D. Singh, Zoo Supervisor, Jodhpur for the opportunity to collect these parasites; and to the Director, Zoological Survey of India, Calcutta for the facilities during the work.





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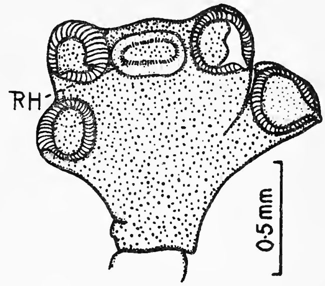

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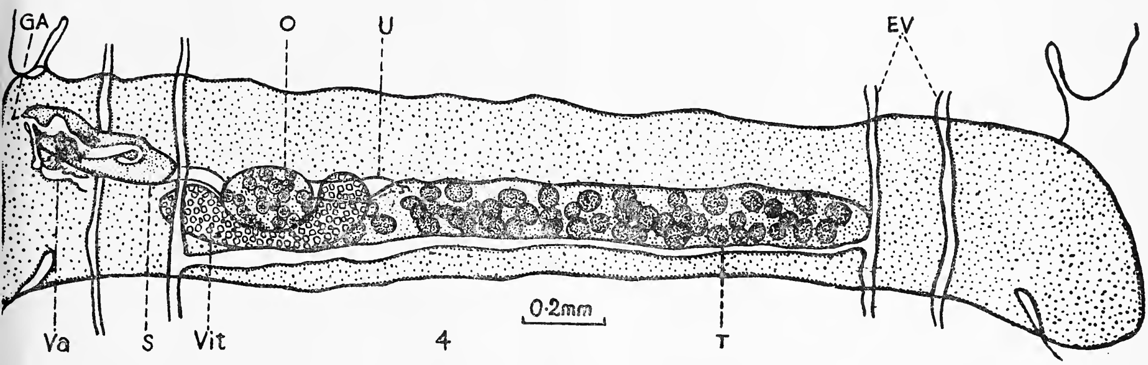

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Schistometra nigriceps sp. nov.

Figs. 1 & 2. Scolex (RH., rostellar hooks).

Fig. 3. Mature segment (Poral part) showing the general shape and position of vitelline gland.

Fig. 4. Mature proglottid showing general anatomy and crescent shaped vitelline gland. (S., cirrus sac; EV., excretory vessels; GA., genital atrium; O., ovary; T., testes; U., uterus; Va., vagina; Vit., vitelline gland).

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A NEW *MARSDENIA* R. BR. (ASCLEPIADACEAE) FROM SOUTH INDIA[1]

A. N. Henry[2] and K. Subramanyam[3]

(*With a plate*)

Marsdenia tirunelvelica sp. nov.

Suffrutex volubilis; caules teretes, brunneoli, glabrati, ramosi. Folia ad 8.5 × 3.8 cm, elliptico-lanceata ad obovata vel pandurata, acuminata, integra, subcoriacea, atrobrunnea supra, infra vero pallida, subglabra, basi obtusa, subtruncata vel subcordata; nervis (lateralibus) 4-5 paribus, infra prominentibus; petioli 2-2.8 cm longae. Flores virido-flavi, cymis umbellatis; pedunculi inter petiolos quorum uno propinquiores, exorientes, teretes, glabri; pedicelli ad 2 cm longi, glabri; bracteae 2.3 × 1 mm, lanceatae, ad basim pedicellorum aggregatae, glabrae, persistentes. Calyx 5-partitus; lobi 2.8 × 1.8 mm, imbricati, elliptico-ovati, ad marginos minute ciliati, glandulosi intra ad basim. Corolla urceolata; tubus 3.5 mm longus, lobi 1.2 × 1.5 mm, torti, late ovati. Corona 5 lobis carnosis et parvis; lobi infra connati, leviter acclives, infra columnam staminalem adnati. Gynostegium 3 mm longum. Apices antherarum membranacei, ovato-oblongi, obtusi, super apicem styli incumbentes; alae antherarum corneae; massae pollinis erectae, minutae, oblongae, ad polliniferentes per caudiculas proprias affixae. Ovarium 2-carpellatum, pluriovulatum; stylus 0.5 mm longus, crassus; apex styli magnus, tholiformis. Fructus non visus.

Holotypus *Henry* 8421 A et isotypi *Henry* 8421 B-F lecti in collibus Agastyamalai dietis in Tirunelveli, in ditione Tamil Nadu ad altitudinum *c.* 1400 m supra mare, die 25-iv-1972; holotypus positus in CAL, isotypi in MH.

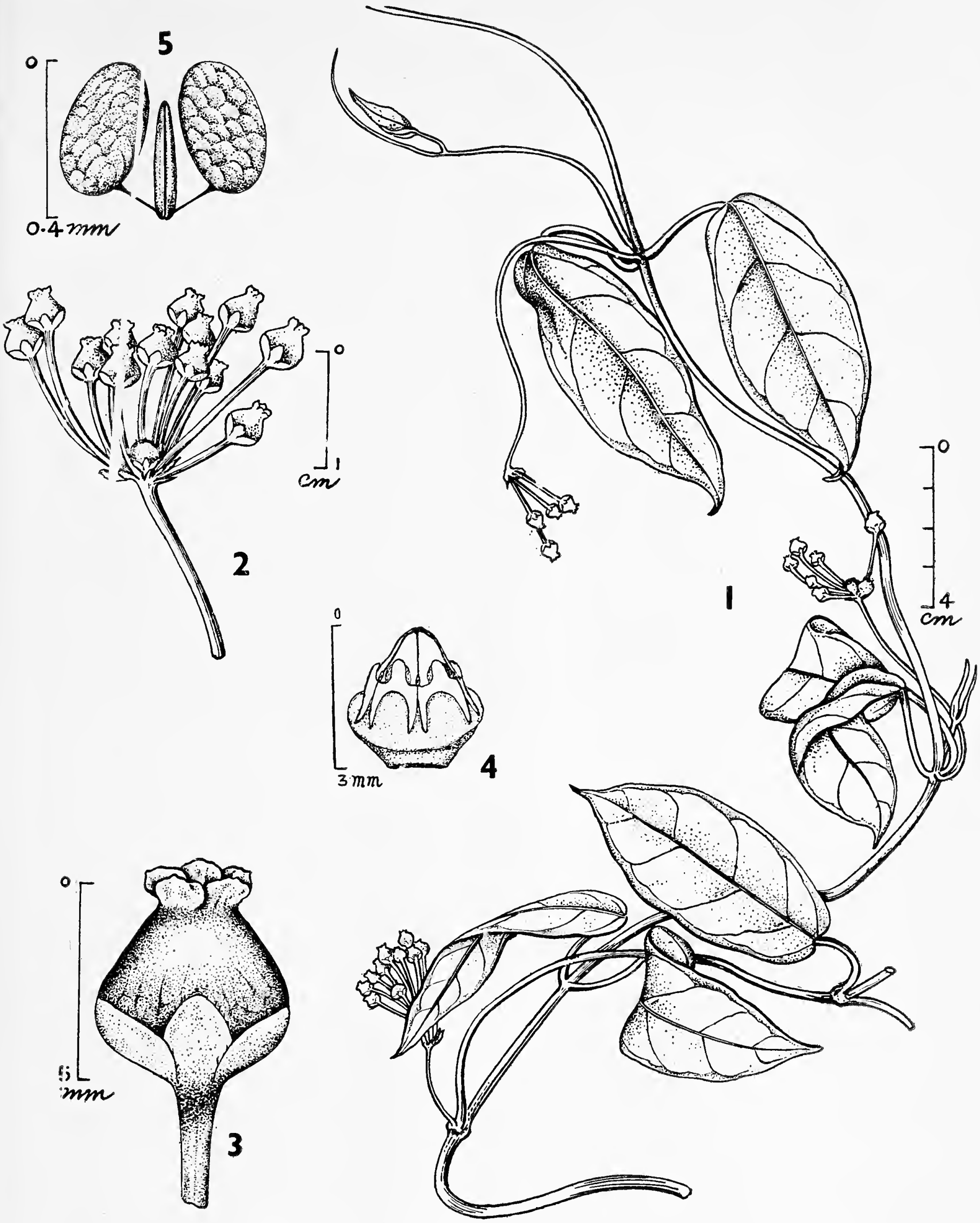
Marsdenia triunelvelica sp. nov.

Twining undershrubs; stems terete, brownish, glabrate, branched. Leaves up to 8.5 × 3.8 cm, elliptic-lanceate to obovate, or pandurate, acuminate, entire, subcoriaceous, dark green above, pale beneath, subglabrous, obtuse, subtruncate or subcordate at base; lateral nerves 4-5 pairs, prominent on the lower side; petioles 2-2.8 cm long. Flowers greenish yellow, in umbellate cymes; peduncles arising between the petioles, closer to one of them, terete, glabrous; pedicels up to 2 cm long, glabrous; bracts 2.3 × 1 mm, lanceate, crowded at the base of pedicels, glabrous, persistent. Calyx 5-partite; lobes 2.8 × 1.8 mm, imbricate, elliptic-ovate, minutely ciliate along margins, glandular at base within. Corolla urceolate; tube 3.5 mm long; lobes 1.2 × 1.5 mm, twisted, broadly ovate,

[1] Accepted February 1976.

[2] Botanical Survey of India, Coimbatore.

[3] Botany Department, Central College, Bangalore.



Figs. 1-5. *Marsdenia tirunelvelica* sp. nov.
1. Portion of plant; 2. Inflorescence; 3. Flower; 4. Gynostegium with staminal corona: side view; 5. Pollen-masses.

Corona of 5 fleshy, small lobes; lobes connate below, sloping a little upwards, adnate below the staminal column. Gynostegium 3 mm long. Anther-tips membranous, ovate-oblong, obtuse, incumbent over the style-apex; anther-wings horny; pollen-masses erect, minute, oblong, attached to the pollen-carriers by distinct caudicles. Ovary 2-carpellate, many-ovuled; style 0.5 mm long, stout; style-apex massive, dome-shaped. Fruit not seen.

Holotype (*Henry* 8421 A) and isotypes (*Henry* 8421 B-F) were collected from Agastyamalai Hills in Tirunelveli district, Tamil Nadu at an altitude of about 1,400 m on 25-iv-1972; holotype has been deposited in CAL and isotypes in MH.

This rare and interesting taxon obviously represents a member of the tribe—*Marsdenieae*. Unfortunately, the generic limits in the *Marsdenieae* have not been adequately worked out in recent times and we found it difficult to place our new species in the appropriate genus. We, however, treat it as a species of *Marsdenia* R. Br. *sensu lato,* as suggested by Dr. D. V. Field of the Kew Herbarium. The structure of the corona and the anther-wings of *M. tirunelvelica* is rather unusual.

Acknowledgements

Grateful thanks are due to Dr. D. V. Field of Kew Herbarium for his valuable opinion on the specimen, Rev. Dr. K. M. Matthew, S.J. of the Rapinat Herbarium, Tiruchirapalli for the Latin description, and Mr. M. Chandrabose, Botanist, Botanical Survey of India, Coimbatore for helpful suggestions. One of us (K.S.) is thankful to the UGC for financial assistance.

A NEW SPECIES OF *TERAMNUS* SW. (FABACEAE) FROM MANBHUM (INDIA)[1]

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Sibpur, Howrah 3

During a revision of the genus *Teramnus* Sw. I came across some specimens doubtfully identified. One such specimen collected by V. Ball. s.n. in 1866-67, from Manbhum (W.B.) previously identified as *Teramnus labialis* Spreng., proves on careful examination to be different from *T. labialis* Spreng. As its characters are indicative of a new species, it is described and named here.

Teramnus hookerianus sp. nov.

Haec species differt a. *T. labialis* Spreng. foliolis parvioribus (1-1.9 cm), falus glabris, stipulis majoribus (4.5 mm), fructibus parnioribus ane (3.5-4 cm).

Harbae volubiles, 25 cm longae, caules graciles internodiis ca 2-7 cm longis cum pilis paucis adpressis. Folia pinnatim trifoliata, petio-

[1] Accepted February 1976.

lata, petioli 1-2.5 cm, petioluli 1-6 mm longi, glabri, cum pilis paucis adpressis; folioli parvi, 1-1.9 cm longi, 1-1.35 cm, lati, stipulati, ovati, ciliati, truncati, acuti, coriacei, supra pallidi, adpresso-pilosi in costulis, infra glabri, stipulae 4.5 mm longae, spinosae. Inflorescentia racemosa, ca 4 cm longa, bracteata; bractea 1.5 mm bracteola 1.5 mm lanceolata, flores 4 mm × 1.5 mm, colorati, pedicellati, pedicellus 2 mm longus. Calyx 5-dentatus, ad basin connatus, segmentum unusuquisque ca 3 mm, segmenta lanceolata, glabrescentia, viridia, valvata, unum segmentum aliis 4 segmentis majus. Corolla papilionacea, colorata, vexillum 3.5 × 2 mm, ovatum, ala 3 × 1 mm, carina 3 × 1 mm, deorsum libera, sursum connata. Stamina diadelpha, alterna sterilia; carpellum apocarpum; ovarium elongatum, 3 mm longum, placentatio marginalis, ovula multa; stylus 5 mm longus, stigma lineare. Fructus leguminiformis, 3.5-4 mm longus, 2.5 mm latus, rostratus; semina multa, septata.

Teramnus hookerianus sp. nov.

This species differs from *T. labialis* Spreng. in the smaller leaflets (1-1.9 cm), glabrous leaves, larger stipules (4.5 mm) and smaller fruits (0.5-9 cm).

Twining herbs, 25 cm long, stem slender, branched, internodes about 2-7 cm long with a few adpressed hairs, glabrous, leaves pinnately 3-foliolate, petiolate, petiole 1-2.5 cm, petiolules 1-6 mm long, with a few adpressed hairs, glabrous. Leaflets small, 1-1.9 cm long, 1-1.35 cm broad, stipulate, ovate, ciliate, truncate, acute, coriaceous upper side paler, hairs on the costules, adpressed, lower side glabrous, stipules 4.5 mm long spinuous. Inflorescence raceme, about 4 cm long, bracteate, bract 1.5 mm, bractiole 1.5 mm long, lanceolar. Flower 4 × 1.5 mm, coloured, pedicellate, pedicel 2 mm, Calyx 5 toothed, united at the base, each segment about 3 mm, lanceolate, one segment larger than the other 4 segments, glabrescent, green, valvate. Corolla papillionaceous, coloured, standard 3.5 × 2 mm, ovate, wing 3 × 1 mm, keel 3 × 1 mm, free at the lower part, upper part united. Stamens diadelphous, alternate stamens sterile, carpel apocarpous, ovary elongated 3 mm long, style 5 mm long, stigma linear, placentation marginal, ovules many. Fruit pod like, 3.5-4 cm long, 2.5 mm broad, beaked, seeds many, septate.

HOLOTYPE

India, West Bengal, Manbhum (Purulia) 1866-67, V. Ball s.n. Acc. No. 125331 (Deposited in the Central National Herbarium, Calcutta).

PARATYPE

India, Madras; M. S. Ramaswami, 1015, Acc. No. 125305, Bengal, Bankura, Bishnupur, Koch Birai Canal; M. N. Sanyal, 532 (Deposited in the Central National Herbarium, Calcutta).

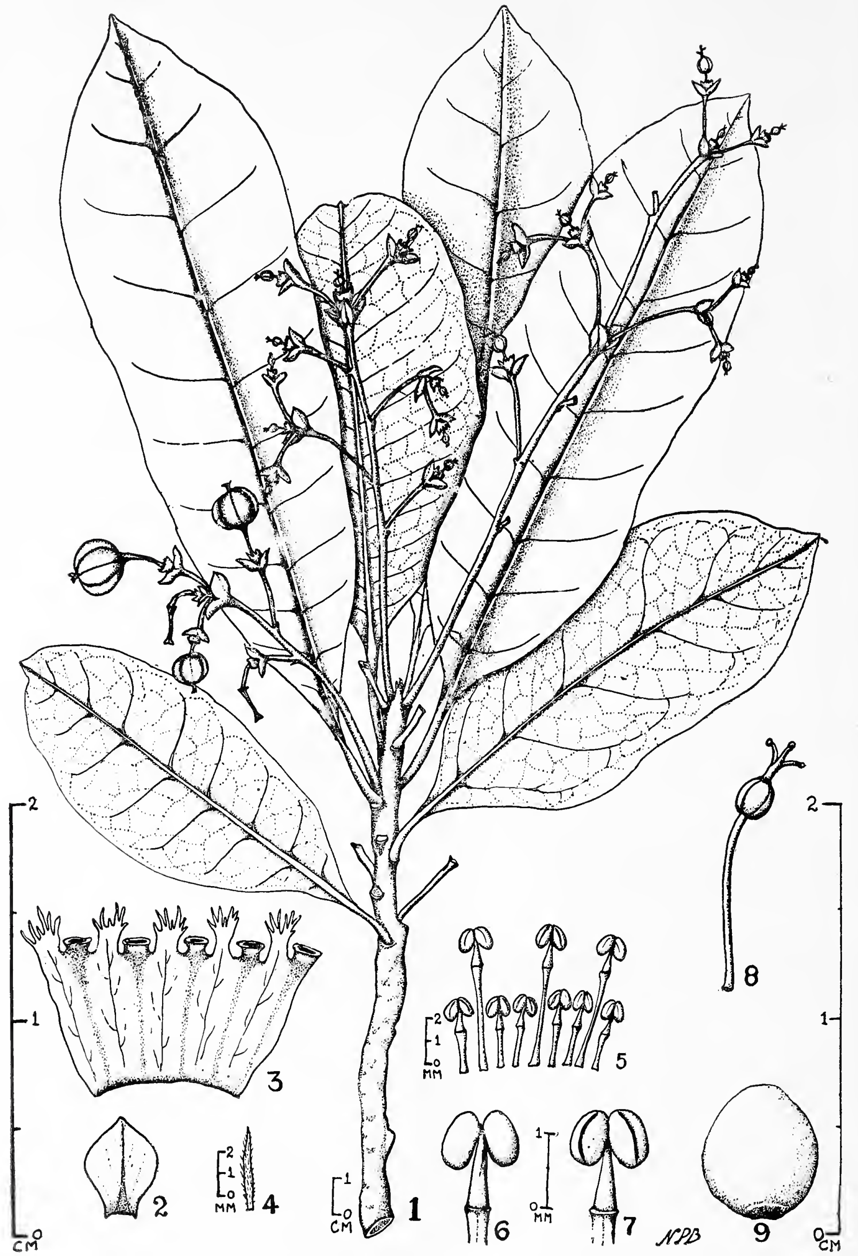
Key to the genera

1 Leaflets longer, subcoriaceous
- 2. Stem and leaflets glabrous, leaflets 7.5-12.5 cm long, racemes 2.5 cm or less long, pods glabrous, 6.25-7.5 cm long...... *T. flexilis*
- 2. Stems and leaflets pubescent, leaflets 3.5-6 cm long, racemes 4.5-5.5 cm long pods pubescent. .... *T. debilis*

1 Leaflets smaller, coriaceous
- 3. leaflets 2.5-6.5 cm long, stipules 2 mm long, pods 5-6.5 cm long .... *T. labialis*
- 3. leaflets 1-1.9 cm long, stipules 4.5 mm long, pods 3.5-4 cm long ...... *T. hookerianus*

Acknowledgements

I am grateful to Deputy Director and Keeper, CNH, B.S.I., Calcutta for providing facilities for this work. Thanks are also due to Dr. N.C. Majumdar for the Latin translation and Sri P. R. Sur for his encouragement and keen interest in preparing the manuscript of this note.



Euphorbia tavoyensis sp. nov.

1. terminal portion of plant; 2. floral leaf; 3. involucral cup, opened out; 4. bract of male flower; 5. male flowers, showing two sizes; 6. stamen, dorsal view; 7. stamen, ventral view; 8. female flowers; 9. seed.

A NEW SPECIES OF *EUPHORBIA* (EUPHORBIACEAE) FROM BURMA[1]

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Botanical Survey of India,
Andaman-Nicobar Circle, Port Blair
(*With a plate*)

Euphorbia tavoyensis sp. nov.

Pertinet ad sectionem *Laurifoliae* affinisque est *E. laurifolio* Lamk. a qua imprimis differt foliis amplioribus oblanceolatis; paniculis longioribus quam vel brevioribus foliis, multi-ramosis, cymis 1-3 cyathiatis; involucris glabris; lobis involucralibus longioribus quam glandibus; stylis connatis per dimidia longitudines simplicibus.

Suffrutex, 1.0-1.5 m altus, pauciramosus. *Folia* spiratim disposita, aggregata versus apices, oblongo-lanceolata, cuneata vel subobtusa ad bases, obtusa, subacuta vel subemarginata ad apices, integra vel leviter sinuata, minute recurvata et subcartilaginea ad margines, 9-24 cm longa, 4-8 cm lata; nervi lateralis 7-15 binati, irregulares, horizontales; petiolus 1-4 cm longus. *Panicula* subcorymbosa, 6-24 cm longa, non ramosa per dimidia longitudinem; rami simplices vel ternati; cyathia solitaria vel in cyma ternatis, si ternata nunc cyathia centrales sessiles vel subsessiles et cyathia laterales pedunculata; cyathiorum pedunculi crassi, usque ad 1.5 cm longos; bracteae ad paniculorum ramos et cyathiorum bases binatae, oppositae, ovato-deltoideae, obtusae, sessiles, 3-5 mm longae, 3-4 mm latae. *Involucrum* obconicum, 3-4 mm longum, 2-3 mm latum ad orem; lobi fimbriati ad apices, ± 1 mm longi; glandes 5, oblongae, ± 0.5 mm longae, ± 1 mm latae. *Flores masculi* multi; bracteolae lineares, 3-4 mm longae, pubescentes; pedicelli 2 vel 4 mm longi, aggregati in tribus, duobus brevibus et uno longo; filamenta ± 1 mm longa, angustata ad apices; antherae ± 1 mm latae, ± 0.5 mm longae. *Flores feminei* singulares; pedicellus 8-10 mm longus, ovarium subglobosum, 1.0-1.5 mm longum, 0.9-1.2 mm latum; columna stylaris ± 1 mm longa; rami stylares 1-2 mm longi; stigmata capitata. *Capsula* depressa, globosa, 3-cellularis, ± 1 cm longa, ± 1.2 cm lata; semina 3, subglobosa, ± 6 mm longa, ± 5 mm lata, laevia.

BURMA: Heinye headwaters, Tavoy, ± 650 m, 25 Nov. 1921, *P. T. Russell* 2216 C (Holotypus in CAL); 2216 A, B (Isotypi in CAL). Ridge between Kyong Pyu Chaung and Talaingya, Tavoy, ± 600 m, 1 Feb. 1919, *A. T. Gage* 26 A-E (Paratypi in CAL).

Euphorbia tavoyensis sp. nov.

Belongs to section *Laurifolia* and is related to *E. laurifolia* Lamk. from which it differs particularly in larger oblanceolate leaves; panicles as long as or shorter than leaves, many-branched; cymes 1-3 cyathiate; involucre glabrous; involucral lobes longer than glands; styles united for half the length, simple.

Undershrub, 1.0-1.5 m high, few-branched. *Leaves* spirally arranged, more or less crowded towards apex, oblong-lanceolate, cuneate or subobtuse at base, obtuse, subacute or subemarginate at apex, entire or faintly wavy, minutely recurved and subcartilaginous at mar-

[1] Accepted February 1976.

gins, 9-24 cm long, 4-8 cm wide; lateral nerves 7-15 pairs, irregular, horizontal; petiole 1-4 cm long. *Panicle* subcorymbose, 6-24 cm long, unbranched for half the length; branches simple or ternate; cyathia solitary or in ternate cymes, if ternate then the central cyathium sessile or subsessile, lateral ones pedunculate; peduncles of cyathia thick, upto 1.5 cm long; bracts at branches of panicles and bases of cyathia, paired, opposite, ovate-deltoid, obtuse, sessile, 3-5 mm long, 3-4 mm wide. *Involucre* obconical, 3-4 mm long, 2-3 mm wide at mouth; lobes ± 1 mm long; glands 5, oblong, ± 0.5 mm long, ± 1 mm wide. *Male flowers* many; bracteoles linear, 3-4 mm long, hairy; pedicels 2 or 3 mm long; in groups of three with two short and one long; filaments ± 1 mm long, narrowed at apex; anthers ± 1 mm wide, ± 0.5 mm long. *Female flowers* solitary; pedicel 8-10 mm long; ovary ovoid-subglobose, 1.0-1.5 mm long, 0.9-1.2 mm wide; style column ± 1 mm long; style-branches 1-2 mm long; stigma capitate. *Capsule* depressed-globose, 3-celled, ± 1 cm long, ± 1.2 cm wide; seeds 3, subglobose, ± 6 mm long, ± 5 mm wide, smooth. (Figs. 1-9).

The section *Laurifoliae* of *Euphorbia* is entirely tropical American and it is rather strange and interesting that a solitary species of this section should be found in Burma.

POGONATHERUM SANTAPAUI SP. NOV. (POACEAE)—A NEW GRASS FROM INDIA[1]

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Botanic Garden, Howrah 3
(*With nine text-figures*)

During the revision of the genus *Pogonatherum* P. Beauv. I came across some specimens which needed re-examination of identification. One of such specimens collected by J. N. Vohra 11248 from Garhwal (India) previously identified as *Pogonatherum paniceum* (Lamk.) Hack., on careful examination proves to be different from *P. paniceum* (Lamk.) Hack. Its characters indicate an undescribed species and it is described and named here.

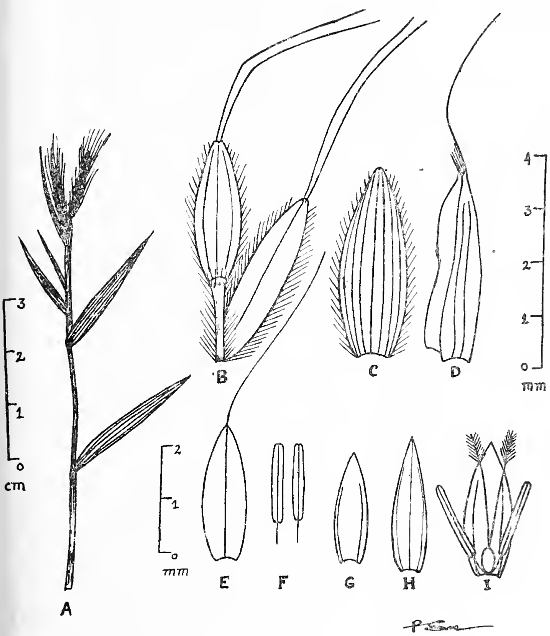
Pogonatherum santapaui sp. nov.

Species haec ah *Pogonatherum paniceum* (Lamk.) Hack. differt foliis parvioribus, sessili spicula longiore, arista glumae superioris parviore, arista lemmatis inferioris parviore, palea edentata flosculi inferioris spiculae sessilis.

Herba perennis. *Culmi* 31 cm alti, glabri, 8-10 nodi, ramosi. Folia 1.5-3.8 cm longa, 5 mm lata, lanceolata, ad acumen angustata, basi rotundata, 4-5 nervata, glabra. *Ligulae* ad pilos redactae. *Inflorescentia* 2.9-3.1 cm longa. *Spicula* sessilis 3.5 mm longa, oblonga, callo pervo cum pilis albis. *Gluma inferior* 3.5 mm longa et 1.5 mm lata, oblonga ad apicem pilosa, ad dorsum convexa, ad marginem pilis parvis. *Gluma superior* 3.5 mm longa, ovata, mem-

[1] Accepted August 1975.

branacea, carinata, aristata, *arista* 7.5-9 mm longa. *Flosculus inferior* mas, *lemma* 2.5 mm longum, lanceolatum, hyalinum, aristatum, *arista* 9-10 mm longa. *Stamina* 2, *palea* 2.5 mm longa, lineari-lanceolata. *Flosculus superior* hermaphroditus, 3 mm longus, lanceolatus, hyalinus. *Stimina* 2, anthera 2 mm longa, *stylus* paleam acquantes, *palea* 3 mm longa, ovata, hyaline. *Spicula pedicellata* 2.5 mm longa, lineari-lanceolate. *Gluma superiora* 2.4 mm longa, aristata, *arista* 5 mm longa. *Gluma floralis* 2 mm longa, lanceolata, hyalina, aristata, *arista* 5 mm longa.



Pogonatherum santapaui sp. nov. (A-I)
A. A part of a flowering branch; B. Spikelets; C. Lower glume; D. Upper glume; E. Lower Lemma; F. Stamens; G. Palea; H. Upper lemma; I. Androgynoecium with palea.

Pogonatherum santapaui sp. nov.

This species differs from *P. paniceum* (Lamk.) Hack. by the smaller leaves, larger sessile spikelet, smaller awn of upper glume, smaller awn of lower lemma and toothless palea of lower floret of sessile spikelet.

Herb perennial. *Culms* 31 cm tall glabrous, 8-10 noded, branched. *Leaves* 1.5-3.8 cm long and 5 mm broad, lanceolate acuminate, tapering to a fine point, base 4-5 nerved, glabrous. *Legules* reduced to hairs. Inflorescence 2.9-3.1 cm long, *sessile spikelet* 3.5 mm long, oblong, callus small with white hairs, *lower glume* 3.5 mm long and 1.5 mm broad, oblong, hairy at the top, back convex, little hairs at the margin. *Upper glume* 3.5 mm long, ovate, membranous, keeled, awned, *awn* 7.5-9 mm long. *Lower floret* male *lemma* 2.5 mm long, lanceolate, hyaline, awned, *awn* 9-10 mm long. *Stamens* 2, palea 2.5 mm long, linear-lanceolate. *Upper floret*—hermaphrodite, 3 mm long, lanceolate, hyaline. *Stamens* 2, *anther* 2 mm long, *style* as long as palea. *Palea* 3 mm long, ovate, hyaline. *Pedicelled spikelet* 2.5 mm long, *lower glume* 2.5 mm long, linear lanceolate. *Upper glume* 2.4 mm long, keeled, awned, *awn*—5 mm long. *Floral glume* 2 mm long, lanceolate, hyaline, awned, *awn* 5 mm long.

KEY TO THE SPECIES OF *Pogonatherum*

1. Racemes upto 4 cm long, nodes bearded; spikelets upto 3.5 mm long.
    2. Spikelets 2.5-3.5 mm long, callus hairs upto 1.5 mm long lower floret male; upper floret with 2 stamens.
        3. Leaves 3.4 cm long and 0.5 mm broad, palea of lower floret of sessile spikelet not toothed, awn of lemma of lower fforet 10 mm long .... *P. santapaui*
        3. Leaves 6.5 cm long and 0.25 mm broad, palea of lower floret of sessile spikelet two toothed, awn of lemma of lower floret 17 mm long .... *P. paniceum*
    2. Spikelets not more than 2 mm long; callus hairs about 2 mm long; lower floret empty or obsolete, upper floret with 1 (rarely 2) stamen .... *P. crinitum*

1. Racemes more than 4 cm long; nodes glabrous, spikelets 4-5 mm long ...... *P. rufo-barbatum*

Holotype: INDIA, Uttar-Pradesh, Garhwal, altitude 700 m, 26 February 1960, J. N. Vohra 11248.

Etymology: This species is being named in honour of the great botanist the late Dr. H. Santapau, former Director, Botanical Survey of India.

ACKNOWLEDGEMENTS

I am grateful to the Director, Botanical Survey of India, Calcutta for facilities; to Deputy Director and Keeper, Central National Herbarium, Calcutta for encouragement; to Dr. S. K. Jain, Deputy Director, Eastern Circle, B.S.I. for valuable suggestions; and to Dr. N. C. Majumder for the Latin diagnosis.

A NEW SPECIES OF *PSEUDANTHISTIRIA* (HACK.) HOOK. F. FROM INDIA[1, 2]

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(*With five text-figures*)

The genus *Pseudanthistiria* was established by Hooker in (1896) on the base of Hackel's section *Pseudanthistiria* belonging to the subgenus Hypogynium of *Andropogon* Linn. He (Hooker) described four species, three of which are found in India and one in Burma. Bor (1960) has also recorded these four species. A new species of *Pseudanthistiria* has recently been found in India. Thus making a total of five species under the genus. The new species is described below and the distinguishing key characters of the four Indian species of *Pseudanthistiria* have also been given.

Pseudanthistiria intermedia sp. nov.

Allied to *P. hispida* Hook. f. and *P. heteroclita* (Roxb.) Hook. f. but differs in the lower glume of the sessile spikelet which has stiff hairs on the margin but is totally glabrous in the middle (Figs. 5, a-I, a-II and a-III).

P. hispidae Hook. f. et *P. heteroclitae* (Roxb.) Hook. f. affinis attamen spiculae sessilis gluma inferiore ad centrum omnino glabra ad marginem hispida differt.

Annual; *culms* erect or geniculately ascending, terete, simple or branched, glabrous, polished, many noded, nodes glabrous (Fig. 1); *leaves* covered more or less with tubercle-based hairs, not rounded at the base, linear and long, primary nerves on both sides of the midrib distinct, margins glabrous or with long tubercle-based hairs; *ligule* truncate, ciliate; *panicle* leafy elongate or simple with many short peduncled fascicles of pseudoracemes;

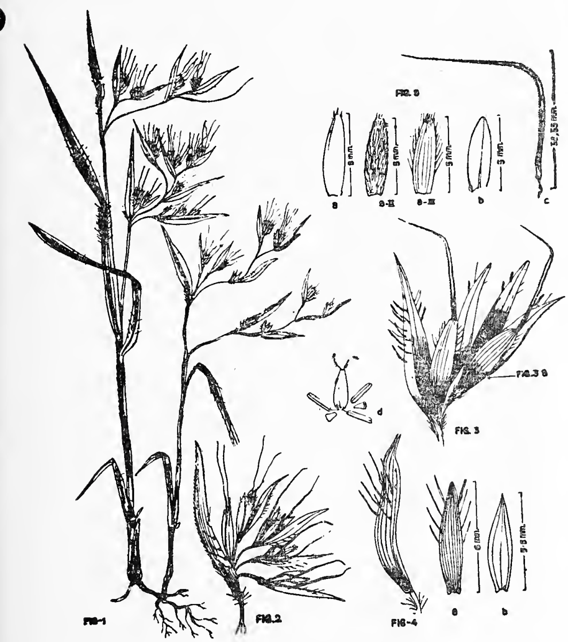
[1] A part of the Ph.D. Thesis submitted by the Senior author to the Mahatma Phule Krishi Vidyapeeth, Rahuri, District Ahmednagar.

[2] Accepted August 1975.

[3] *Present address*: Reader in Botany, Botany Dept., Post Graduate School, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar.

[4] Behind Municipality, Margao, Goa.

fascicle of pseudoraceme often in pairs arising from a common outer spathe 40-50 mm long with bulbous hairs, much longer than pseudoraceme (Fig. 2); *pseudoraceme* of five spikelets without involucral ones; *peduncle of pseudoraceme* 1.5 mm long and hairy; *spikelets of pseudoraceme,* enclosed in the spatheole having long cilia on the keel and a fringe of hairs at the base, supported by small pedicels (Fig. 3); *pedicelled spikelets* empty, 5-6 mm long with tubercle based hairs on the surface (Fig. 4); *lower glume* 5-6 mm long (Fig. 4a), many nerved, margins with bulbous based hairs on the surface; *upper glume* 1 mm long, lanceolate and 3 nerved (Fig. 4b); *bisexual spikelets* (Fig. 3a) usually 2, awned; *lower glume* (Fig. 5a-III) glabrous in the middle surface and shortly hispid on the margins; lower and upper glume (Fig. 5b) 5-6 mm long; *lower floral glume* (lemma) absent; *awn* (Fig. 5c) 30-35 mm long, ciliate; stamens 3; ovary 1, with lodicules 2 (Fig. 5d).



Figs. 1-5. *Pseudanthistiria intermedia* sp. nov. (1) A drawing of a herbarium specimen; (2) A fascicle of a pseudoraceme; (3) Pseudoraceme with bisexual and pedicelled spikelets; (4) Pedicelled spikelet: (a) Lower glume, (b) Upper glume; (5) a-I. lower glume of bisexual spikelet of *P. hispida;* a-II. Lower glume of bisexual spikelet of *P. heteroclita;* a-III. Lower glume of bisexual spikelet of *P. intermedia;* b-Upper glume *P. intemedia;* c-Awn; d-Ovary with anthers and lodicules

Holotype collected at Satpura (Toranmal) Range, Khandesh, Maharashtra, India by the Senior Author on 17th November, 1968 under the field No. I-681 BC. and deposited in the Herbarium of Prof. of Agril. Botany, College of Agriculture, Poona 411 005. Two isotypes bearing the same number have also been deposited in the Herbarium of the Botanical Survey of India, Western Circle, Poona 411 001.

Key

(1) Culms erect, robust; leaves covered more or less with tubercle based hairs, not rounded at the base, linear and long, primary nerves, on both sides of the midrib distinct.

(2) Lower glume of fertile spikelet shortly hispid, rachis or (peduncle of the unit) of the paired fascicle of pseudoraceme 5 mm long; spatheole ciliated with small cilia on the keel and at the base covered with fringe of hairs, peduncle of pseudoraceme 1 mm long and glabrous...... .... *P. hereroclita*
Lower glume of fertile spikelet quite glabrous, rachis or (peduncle of the unit) of the paired fascicle of pseudoraceme 6 mm long; spatheole ciliated with long cilia, and glabrous base except 1 or 2 hairs; peduncle of pseudoraceme 1.5 to 2 mm long but hairy ...... *P. hispida*
Lower glume of fertile spikelet glabrous in the middle surface and shortly hispid on the margin; rachis or (peduncle of the unit) of the paired fascicle of pseudoraceme 8 mm long; spatheole on the keel covered with large cilia (as in *hispida*) while fringe of hairs present at the base of the spatheole (as in *hereroclita*),

peduncle of pseudoraceme 1.5 mm long and hairy .... *P. intermedia*

(1) Culms prostrate, filiform, weak, rooting at the nodes; leaves glabrous on both the surfaces, rounded at the base, rather short and small, lanceolate, primary nerves of the leaf not distinct.

(2) Lower glume of fertile spikelet totally glabrous, rachis or (peduncle units) of the paired fascicles 11 mm long, spatheole glabrous on the keel and base; peduncle of pseudoraceme 2-6 mm long and glabrous .... *P. umbellata*

Etymology

The species is named *P. intermedia* as it has some characters of *P. hispida* and others of *P. heteroclita.*

ACKNOWLEDGEMENTS

We are grateful to the Director, Royal Botanic Gardens, Kew, England for confirming the identification of the species and to Rev. Cecil J. Saldanha, S.J. for the Latin translation of the diagnostic characters. The drawings were made by Shri R. B. Bhandarkar, Commercial Artist.

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A NEW SPECIES OF *CARALLUMA* (ASCLEPIADACEAE) FROM INDIA[1]

G. R. KUMARI AND G. V. SUBBA RAO
Botanical Survey of India, Southern Circle, Coimbatore 2

(*With twelve text-figures*)

Caralluma nilagiriana sp. nov.

Affinis *C. truncato-coronate* (Sedgwick) Grav. & Mayur. tamen differt radicibus non succulentis, foliis deltoideis, pedicellis brevioribus, bracteatis, glandibus pellucidis extrinsecus floribus et pedicellis, corollis extus viridis et punctis roseis particulis nullis clacatis sinubus loborum corollarum. Typus: Cult. ex Dist. Nilgiri, *Subbarao et Kumari* 39262 A (holotypus, CAL).

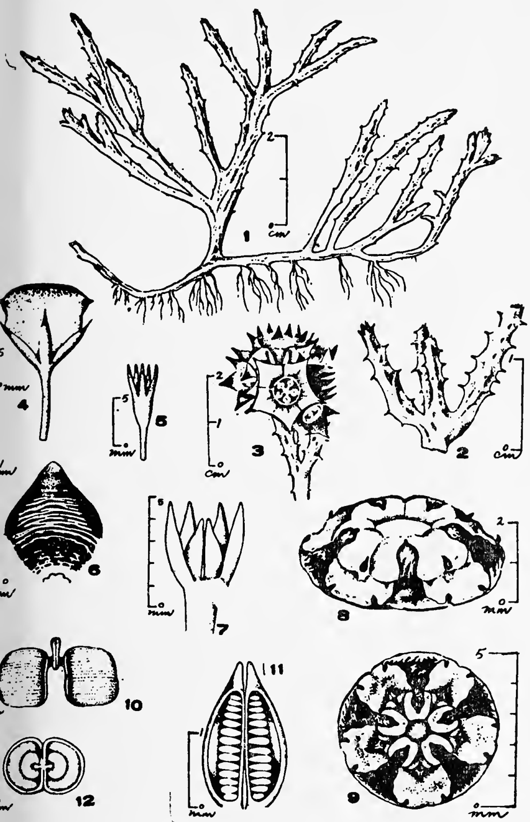
Caralluma nilagiriana sp. nov.

Allied to *Caralluma truncto-coronata* (Sedgwick) Grav. & Mayur but differs from it in having non succulent roots, deltoid leaves, shorter pedicels, bracteoles, pellucid glands on flowers and pedicels, corolla outside green and mottled with pink, no clavate particles at the sinuses of corolla lobes.

Fleshy glabrous perennial herbs upto 9.5 cm high, spreading by suckers; prostrate branches rooting. Branches slender, not tapering, 4 angled, 6 mm wide, sides deeply furrowed. *Leaves* minute, deltoid, arising on the tubercles of the angles. *Inflorescence* terminal, umbellate. *Flowers* 6-19 with foetid smell, covered externally with pellucid glands; bracts 2 mm long, linear; bracteoles longer than bracts, filiform; pedicels 6-8 mm long, covered with pellucid glands. *Calyx* divided upto the base; segments 5, alternating with corolla lobes, 4 mm long, linear, acute. *Corolla* 2 cm across, outside green mot-

[1] Accepted February 1976.

tled with purple; tube cupular, 6-9 mm in diameter, with 3 distinct rings of coloration: a deep purple ring at the middle with green pellucid transverse furrows separates a deep purple continuous ring at the mouth and a pale green broader ring with pellucid glands at the bottom; limb valvate, five fid, divided more than half way; lobes deltoid, acute, glabrous, deep purple inside with transverse callosities and pale green pellucid interrupted circles. In dried and pressed specimens the venation of corolla lobes is quite distinct; each corolla lobe three ribbed, with reticulate venation. *Corona* 5 mm in diameter, staminal, thick, dark purple; outer corona 5 lobed, truncate, lobes prominently cuspidate on either side; inner lobes ligulate, elongate, ascending and appressed to dorsal sulcate surface of anthers; staminal column short, incumbent on the stigma; anthers yellow, lobes broadly elliptic. *Pollinia* yellowish red, compressed, erect, ± oblong obtuse, faintly transversely striped; attached laterally to the erect purple corpusculum by means of caudicles, pellucid along the inner



Caralluma nilagiriana sp. nov.

1. Plant. 2. Part of the plant enlarged. 3. Inflorescence. 4. Flower bud. 5. Calyx. 6. Corolla lobe (upper surface). 7. Calyx split open showing ovary. 8. Corona (side view). 9. Corona. 10. Pollinia. 11. L.S. of ovary. 12. T.S. of ovary.

C. truncato-coronata (Sedgwick) Grav. & Mayur.	*C. nilagiriana* sp. nov.
Plants upto 15 cm high.	Plants upto 9.5 cm high.
Roots succulent.	Roots not succulent.
Leaves ovate.	Leaves deltoid.
Bracts 2.5 mm long.	Bracts 2 mm long.
Bracteolate.	Bracteolate.
Corolla and pedicels glandular.	Corolla and pedicels pellucid glandular externally.
Pedicels 17 mm long.	Pedicels upto 8 mm long.
Clavate particles present at the sinuses between corolla segments.	No clavate particles occur at the sinuses between corolla segments.

margin. *Ovary* bicarpellary, 2 mm long, glabrous; stigma 5 angled. *Follicles* not seen.

HOLOTYPE *Subbarao & Kumari* 39262 A and Isotypes *Subbarao & Kumari* 39262 B, C, D were collected on 20th August, 1974 from the garden of Botanical Survey of India, Southern Circle, Coimbatore (from cultivated material raised from wild plants collected in vegetative condition, growing in rocky areas on way from Anaikatty to Ebanad at 900 m alt., in Nilgiri District, Tamil Nadu). Paratypes *Subbarao &*

Kumari 39263 A & B, 39287 A, B & C and 46087 A & B were collected from the same plant and same locality on 21st August, 1974, 16th December, 1974 and 4th November, 1975 respectively. Paratypes *Subbarao* & *Kumari* 37329 A & B were collected on 23rd November, 1970 on way from Anaikatty to Ebanad at 900 m altitude. Holotype is deposited in the Central National Herbarium (CAL) and Isotypes and Paratypes in the Herbarium of the Southern Circle, Botanical Survey of India, Coimbatore (MH).

Note: Corolla segments are spreading in fresh flowers. They tend to become erect after 2 or 3 days and then fold and dry up.

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Reviews

1. ENVIRONMENTAL PROTECTION. By Emil T. Chanlett. McGraw Hill Inc. International Student Edition. Paperback. Pp. xvi + 570 (21 × 15 cm) with many illustrations. Tokyo, 1973. McGraw Hill Kogakusha Ltd. Price not stated.

This book ranges over a variety of topics and disciplines, an understanding of which is necessary for a worker in environmental protection. Courses on this subject are offered in several North American Universities, for which this is designed.

It is unlikely that this very comprehensive book would be studied in detail by all students but it constitutes an excellent handbook for graduate students and workers especially in the fields of health, sanitary engineering and industry who require an acquaintance with factors affecting the environment which lie outside their own field of specialisation. While primarily a handbook of the hazards which man encounters in his environment (including the man made hazards), a wealth of information of interest to the environmentalist and conservationist is found in its pages.

The first chapter discusses the consequences of mismanagement of the major components of our environment and the exponential growth of population, production, power, places and pollutants which lead to such mismanagement. There are brief discussions of Ecology and Ecosystems, quality of the environment and resource management followed by the appreciation that practical efforts at resource management are based firstly on health effects, secondly on consideration of comfort, convenience, efficiency and aesthetics, and thirdly the effects on the balance of ecosystems and natural resources; the order reflecting the urgency of problems arising out of these aspects as well as the level of knowledge we can bring to bear on them.

Chapter two gives an excellent analysis of environmental factors in the spread of communicable diseases. A discussion of the Delhi epidemic of Infectious Hepatitis of 1958 in this chapter and at relevant parts of subsequent chapters, shows the classical picture of an explosive water borne epidemic outbreak.

Further chapters deal with topics like water, air, disposal of excreta, vector control, etc. and the last three chapters deal with energy, natural and man made, in the environment, including ionising radiation, electromagnetic energy, lasers, radio, microwave, etc. and with Heat and Sound.

The treatment of each topic is distinctive and original and covers the need (for management), the scope of the problem and the quantitative factors to be considered, methods, changes and trends, etc. Each chapter concludes with an Appraisal, with attention to secondary hazards which may arise from some of the methods in use. A surprising omission is the absence of any mention of biogas, its importance for waste disposal, energy and fertiliser production in rural communities, in the discussion on animal and farmyard wastes.

The text is illustrated with explanatory drawings, charts and factual data in tabular form. The references quoted are generally informative and include some of the classical works

on the topics covered. Numerous interesting observations and sidelights enliven the text, which is stimulating and thought provoking and hardly ever becomes a mere catalogue of facts. This is a book for the student, for the field worker, or even for the merely curious, to read with interest. The author has achieved a tour de force in presenting with such clarity information from a variety of disciplines.

This book is one of a series on resource management and environmental engineering. It may be too much to expect that all will achieve the same standard of excellence but Dr. Chanlett's book certainly encourages us to await the others with interest.

A.N.D.N.

2. A FIELD GUIDE TO THE BIRDS OF SOUTH-EAST ASIA. By Ben F. King and Edward C. Dickinson. Size 20 × 13 cm, with 26 plates in colour, and 36 plates in monochrome, and many line drawings. London, 1975. William Collins Sons & Co. Ltd. Price £ 4.50.

The names of the book and the publishers should explain the format and quality of this exciting new publication which brings Field Guide treatment of ornithology very close to our own area, and, one is not disappointed. The general arrangement is as in the "Peterson" with identification marks and salient identity points enumerated on the opposite page. 408 species are illustrated in colour, 336 in black-and-white and 161 in line drawings. In all 1157 species of the 1227 species described are illustrated. A herculean task when the outcome has to be a field guide.

By and large, the illustrations are excellent and reproduction good though the ducks, raptors, owls and waders are rather poorly drawn. A disappointment is the absence of pheasants in colour, and many of the bright minivets, leafbirds and ioras are not quite satisfying.

What detracts considerably for an Indian reader is the manner in which English names of species are changed by the authors. An explanation is provided in the preliminary chapters, whereas synonyms are provided for names at variance with Indian usage, this has not always been followed. For example, to take a few, Bluewinged Pitta (*Pitta brachyura*), Greater Goldenback (*Chrysocolaptes lucidus*), Blackrumped Goldenback (*D. benghalensis*), Himalayan Goldenback (*D. shorii*), Orange-backed Woodpecker (*C. validus*). Not only have the names been altered those used by Ripley are not synonimised in many cases as claimed in the introduction, a fixed pattern is not followed as for example the hyphen is used in Orangebacked Woodpecker while it is removed in case of the Goldenback along with the group name "woodpecker". Examples of this sort can be taken from all groups and are a major drawback. Vernacular names have to be standardised but must carefully carry references to other names as used by important works particularly of nearby areas particularly so when names are derived from two such distinct set of workers as the old British, based in India and the new and bludgeoning American in Indo-China and Siam. This omission will keep disturbing Indian birdwatchers who will most certainly purchase this useful and welcome publication. It is hoped that the second edition will have this rectified.

L.J.K.

3. BREEDING ENDANGERED SPECIES IN CAPTIVITY. Edited by R. D. Martin. Pp. xxv + 420. Academic Press, London, 1975. A subsidiary of Harcourt Brace Jovanovich, Publishers. Price £ 12.80.

In reality this book is a collection of papers and reports by well known Directors of Zoological Parks and Trusts presented at the 1972 International Conference on Breeding of Endangered Species hosted by the famous Jersey Wildlife Preservation Trust and Fauna Preservation Society (U.K.). The quality of the papers are of the highest order portraying the achievement and failures of rare species bred in captivity and giving detailed accounts of their management, which includes artificial incubation, rearing, environmental conditions, feeding, capture in the field and release to their natural habitats. The matter covers Reptiles, Amphibians, Birds, and Mammals embracing subjects like Raising and Restocking of Giant Tortoises, Breeding of Endangered Pheasants, Falcons, Waterfowl and Mammals such as Australian Monotremes, Lemurs, Marmosets, Indian Rhinoceros, Cheetah, Arabian Oryx and many others. The subject has been comprehensively covered and practically leaves no stone unturned. There is an excellent Foreword by Gerald Durrell who has shown the way by evolving his Jersey Wildlife Preservation Trust into a model breeding project for endangered species of the world. One of the vital points emphasized by him is that, it should not be claimed that captive breeding of an endangered species should surrogate for the conservation of species in its natural habitat. And that animal husbandry is an art leading to success. There is a long Introduction by the Editor-Composer, R. D. Martin in which he stresses that successful breeding can be attributed to more detailed study of the animal itself in the wild and in captivity in which space and management are important. In fact, many so-called "impossibles" now have been bred in captivity and that those responsible for maintaining rare animals have no reason to despair. A vital contribution to education and to conservation is for zoos to display and breed its rare and common exhibits keeping in mind to maintain a so-called viable unit. Classic examples of breeding endangered species are given, such as *Branta sandvicensis* at the Wildfowl Trust, at Slimbridge (U.K.) and at Hawaii where, reintroduction under a special project in natural habitat conveys how successful such projects can be. Similarly, *Lophura swinhoei* bred at the Pheasant Trust at Great Witchingham (U.K.) was reintroduced to Taiwan. And yet, it is emphasised that such breeding projects closer to the species natural habitats would be more successful, despite the fact that the Whitewinged Wood Duck of India and S.E. Asia has been bred at the Wildfowl Trust. Here are examples of how Trusts can be helpful in saving species in danger of extinction which would be well-worth emulating where our animals are threatened. A paper on Captive Breeding of Crocodiles by H. R. Bustard gives detailed information relevant for saving our Crocodilians. In the mammal section there is a report on breeding of tigers by A.C.V. van Bemmel of Rotterdam Zoo, in which it is expressed that access to fresh air and isolation from the public in breeding dens leads to success. Moreover, innoculation against feline panleucopenia is essential for cubs to prevent infection. In some reports, the complicated dietary prescriptions and recipes for maintaining health are difficult to interpret. It

appears that in some, harmful effects are seen resulting in death of exhibits. Of particular interest is the paper on artificial insemination of birds of prey by R. Fife and their reintroduction in the wild. Also a paper by R. T. Francocur in experimental Embryology as a method of saving rare species. There is an expert summing-up by Sir Peter Scott, Chairman of the conference who says "I believe that it has been positively and quite convincingly established that wild animals *can* be bred in captivity and that more and more species will be bred in future". Doubtless, the book embodies the best collection of scientific information on what has been achieved in the field of captive breeding. Notwithstanding, there are no papers on breeding of Giant Pandas in China nor of Siberian Tigers in the U.S.S.R. or even the Asiatic Lions in India. Most of the matter deals with contributions by Zoos and Trusts as against individuals and aviculturists who have bred innumerable species for the first time in captivity, some of them rare, but not necessarily endangered. Breeding of *Otis tarda* at Berlin Zoo and in some Central European Institutes is not mentioned and yet there are papers on breeding Whooping Cranes and Saddlebacks. To our credit, the Directors of New Delhi Zoological Park, and C. D. Krishna Gowda of Mysore Zoo have presented papers on breeding of Indian Rhinoceros and several other species, the latter rather a sketchy note lacking details. I fully recommend this book as essential for all Zoo Directors and for all Wildlife Conservationists interested in helping to save endangered species. The consolidated work gives a very clear approach on how endangered species can be saved and reintroduced in the wild under proper scientific management. The cost of the book appears high but the knowledge it imparts is of much higher value especially to those who value endangered species and wish to perpetuate them.

R.S.D.

4. BIRDS IN JAPAN—A FIELD GUIDE. By Yoshimara Yamashina. Illustrated by S. Koyabashi. pp. 223 (22.5 × 16 cm), with many illustrations. Tokyo, 1974. Tokyo News Science Ltd. Price $ 29.50 = Yen 4,800.

This useful and attractive 266 page book filled a glaring lacuna when it appeared in 1961. The second impression under review was in 1974. It is a fine book which visitors to Japan would assuredly value as one of the many thoughtful considerations extended them by a remarkable people. The introductory chapters on Japan's geo-history, climate, distribution of birds and their migration are all interesting and valuable sources of information considerably augmented by a section on rewarding bird watching venues in the country.

Each page has a species or two closely related species illustrated at the top with description and salient notes below. The paintings are good and by and large well reproduced, however, one expects far greater quality of both from the Japanese. Even so the distinctive wash technique of Japan makes them rather pleasing. A major error appears to be the placing of some Finches and Tits before the Grebes, far ahead of their legitimate place. There are several typographical errors in the scientific names and the English, both of which could have been avoided. The heavy art paper used throughout the book while making it pleasant to handle, has two disadvantages for a field guide, greater weight and a tendency

for the pages to get stuck when wet.

Of particular worth is the list at the end of the book giving scientific, English and Japanese (written in roman script) names with their status. This throws up by contrast the glaring lack of Indian names for our own birds.

A very authentic and enjoyable book for "armchair" birdwatching in Japan and should find space on a keen birdwatcher's library.

L.J.K.

5. COMPANION TO R. H. BEDDOME'S HANDBOOK TO THE FERNS OF BRITISH INDIA, CEYLON AND THE MALAY PENINSULA. By B. K. Nayar and Surjit Kaur. Pp. xiii + 244 (21.5 × 14 cm). New Delhi, 1974. Otto Koeltz Antiquariat & Pama Primlane. Price Rs. 55.00.

There is no doubt that Col. Beddome's Handbook, 'the only work in which an attempt has ever been made to present a taxonomic survey of all the species of Indian ferns' originally published in 1883 with a supplement added in 1892 (fascimile reprint 1969) there has been a long felt need for revision.

The authors of the COMPANION under review claim to have achieved it. The COMPANION contains two parts. Part I—has nomenclatural changes by B. K. Nayar and Surjit Kaur and Part II—has Classification of ferns by B. K. Nayar. There is also an addendum containing a revised nomenclature of the Thelypteroid ferns by B. K. Nayar.

Dr. B. K. Nayar and co-workers have carried out morphological studies on several species of Indian ferns during the past one and a half decades and have received good attention in India. Considering the experience of the senior author, one would have expected a reliable standard of taxonomic revision. Our hopes are however far from fulfilled. The work as presented here has not achieved any of the purposes for which it is published.

A study of the major part of the work—Part I: Nomenclatural changes—reveals that the authors are completely ignorant about the Articles, Rules and Recommendations of the International Code of Botanical Nomenclature. One of the fundamental principles of the code (Principle IV) states: 'Each taxonomic group with a particular circumscription, position and rank can bear only one correct name, the earliest that is in accordance with the rules, except in specified cases". In this COMPANION, authors have given quite a large number of "alternative names" and in "authors' note" they mention: "Whenever alternative names are given, it should be understood that the first name as well as the alternative names following it are subject to controversy and till the controversy is settled, all the names are equally applicable and valid; the choice of the name is entirely upto the student". This concept of the choice of name is unique in the history of botanical nomenclature. The Code covers all possible obstructions in arriving at a single correct name to each taxon and various rules and recommendations are made for implementing the correct name. The problems and controversies which are beyond the scope of the Code are always open to proposition for the conservation of certain names as given in Appendix III of the Code. The suggestion of the alternative names in the COMPANION offends the Code and makes the book of negative merit. Under article 34, the Code mentions:

"When, on or after January 1, 1953, 2 or more different names (so-called alternate names) are proposed simultaneously for the same taxon by the same author, none of them is validly published."

The majority of the new combinations made in the COMPANION are invalid and if they are not validated as per rules, they might have to be simply discarded. In cases where varieties of Beddome have been raised to specific rank, it is necessary to indicate the nomenclatural types (e.g. *Polystichum aculeatum* var. *travancoricum* Bedd. and *P. aculeatum* var. *castaneum* Clarke). While effecting new combinations in two cases, *Arachnioides macrocarpa* (Wall.) comb. nov. and *A. pinnatifida* (Wall.) Comb. nov., Wallich is cited in parenthesis but the basionyms given for the combinations indicate Beddome as the author of the epithet (*Lastraea walkerae* var. *macrocarpa* Bedd. and *L. walkerae* var. *pinnatifida* Bedd.).

Further, *Kaulinia zosteriformis* (Wall.) comb. nov. is based on the basionym *Polypodium zosteriforme* Wall cat. 280 (nom. nud.). Since the basionym itself is a nomen nudum, the new combination is also automatically nomen nudum. *Polypodium ovatum* Wall. et Hook. is transferred to the genus *Neocheiropteris* but the new combination does not show the relation of the name with Beddome when the authors make *N. ovatus* (Bedd.) comb. nov.

The names of the authors and citations of important works have been abbreviated variously:

1. *Asplenium* LINE Spec. Pl. 2:1078, 1753 (see p. 34)
2. *Asplenium* LINN. Spec. Pl. 2:1078, 1754 (see p. 34)
3. *Blechnum* LINNE. Spec. Pl. 2:1077, 1753 (see p. 33)
4. *Asplenium amboinense* WILLD. CAROLI LINNE, Spec. Pl. 303, 1810
5. *Pteris mertensioides* WILLD. Spec. Pl. 5:394, 1810
6. *Asplenium formosum* WILLD. CAROLI LINNE. Spec. Pl. *ed* 4, 5:329, 1810

One single page (p. 43) of the COMPANION has the following different dates for the same publication:

Moore, Index Fil. 340, 1862
Moore, Index Fil. 333, 1861
Moore, Index Fil. 325, 1859
Moore, Index Fil. 334, 1861
Moore, Index Fil. 334, 1859

The whole text of the COMPANION is full of spelling errors and inspite of 4-pages of errata attached, one can find several dozen more.

It is not possible here to produce elaborate comments on the merits of the classification presented by Dr. B. K. Nayar in this review. The classification is actually reproduced from the scheme published by the author in *Taxon* 19:229-236, 1970. While the author has taken a big step forward to suggest a new scheme of classification of homosporous ferns, and presents his views on phylogenetic evolution of different families and subfamilies, he does not support his views by scientific data and methods. The family Cheilanthaceae presented in this new classification is synonymous with Sinopteridaceae Koidzumi and includes all the same genera in the family. In the context of the current state of fern taxonomic problems the author's attempt at classification hardly makes any constructive contribution.

The book is devoid of any production value either.

M.A.

6. A GUIDE TO THE BIRDS OF THE DELHI AREA. By Usha B. Ganguli. Pp. 314 (17 × 24.5 cm), with 18 coloured plates and 2 monochrome plates, illustrated endpapers, and 7 habitat photographs. New Delhi, 1975. Indian Council of Agriculture. Price Rs. 63.00.

On 16th March I received a letter from Dr. B. N. Ganguli informing me of the posthumous publication of his wife's book and that he would be sending me a complimentary copy. This and the fact that I was partly involved in helping to design a few of the plates and the end-papers will explain how close my contacts with the author had been. It was therefore a delight when I was asked to review the book for the Society by Dr. Sálim Ali himself who has written a foreword for the book.

As I skimmed through the pages of the book, I was pleased with the general get up. The illustrations have reproduced well and it was a pleasure to see two promising new bird artists in addition to J. P. Irani who is by now well-known through his illustrations of several of Sálim Ali's books. We can now anticipate some well-illustrated bird books in the country! The seven habitat photographs by Peter Jackson have the stamp of Peter's excellence.

Almost a century of bird notes by various ornithologists form the basis of this handy book. In her accurate—painstakingly so—manner Usha has compiled and put between the covers of one book all that is known about the birds of Delhi to date. The book in its preciseness stands second only to Sálim Ali's works and the gentle lady who endeared herself to so many has fittingly found a place among the ranks of acknowledged ornithological writers.

How meticulous her notes are can be appreciated when I draw attention to the fact that a casual mention by myself in conversation over tea of having noted Redwhiskered bulbuls in St. Stephen's College gardens finds mention in the book!

While she herself was a competent birdwatcher whose visual records were accepted without reservation, she has always given the fullest credit to all those who provided her information or accompanied her at the time of observation. Her caution in identifying birds is highlighted by the frequent use of the word "possible", a trait absorbed, no doubt, in her early birdwatching days, a complete novice, in company of such men as Horace Alexander and General H. Williams.

The Introduction and the Appendix contain a mine of information of the ornithological Delhi which the Delhi Administration officials are well advised to read so that locations mentioned may be carefully preserved to make Delhi a unique city where tourists could perhaps "do" the birdwatching locations in the same manner as the monuments! Infact, by comparing the bird population each decade, the effectiveness of town planning could be gauged. This book might well inspire Delhi planners to preserve and enhance the wonderful admixture of human and avian habitats which make India's capital such a unique and charming city to visit.

Unfortunately the price is far too stiff for average Indian income, a pity since it is they who will finally decide whether the country's flora and fauna are to be preserved or not. Even so, it should prove very popular with the tourists from abroad. It is a valuable addition to my own collection of bird books, the only regret being I cannot get the author's autograph —Usha is no longer with us.

L. J. K.

7. THE HAMLYN GUIDE TO BIRDS OF BRITAIN AND EUROPE. By Bertel Brunn. Illustrated by Arthur Singer. Pp. 319 (19 × 12 cm), with 137 plates and many others illustrating 516 species. All in colour. 448 distribution maps. London, 1974. Hamlyn Publishing Group Ltd. Price £ 1.50.

A further addition to the already rich bird literature in the English language and on the birds of Europe. The excellence cannot be gainsaid with the illustrations by a man of Arthur Singer's abilities. Any book to be able to sell easily in Europe after the wonderful A FIELD GUIDE TO THE BIRDS OF BRITAIN AND EUROPE by Peterson, Mountfort and Hollom already on book shelfs of ornithologists and lay birdwatchers in this country, has to have the hallmark of quality. That the book under review assuredly has this is indicated by the fact that after its first publication in 1970, reprints have appeared in 1971, 1972, 1973 and twice in 1974!

A unique feature of the book is that relevant information, distribution maps and illustrations appear on a two page spread. Besides the main drawings, smaller drawings show flight patterns, juvenile plumages and other characteristic features to thoroughly cover the salient facts for each species important for field identification. The maps have summer range in pink, winter range in blue and sedentary ranges appearing purple.

European birds occurring in N. Africa—Morocco, Algeria and Tunis and the Middle East have the status shown on the map which includes, apart from Iceland, entire European Russia. This brings into purview many species which are not described in the earlier (Mountfort) guide and a large number of species of Indian interest.

A particularly interesting treatment has been the introductory paragraph for each order, and Family, the silhouettes in flight of the family under review with those of the families confusable with it.

The introductory chapters: How to use this book, Identifying birds, song, Miscellaneous factors in identification, Migration, and studying birds are all further assets to the book. A comparative set of drawings showing immature and female buntings further adds to its usefulness.

The only point which reduces the value of this fine book as against the earlier guide is the absence of point indicators which are a copyright of Roger Peterson. Apart from this here is a book worth possessing.

L.J.K.

8. BIRDS OF BRITAIN AND EUROPE WITH NORTH AFRICA AND THE MIDDLE EAST. By Hermann Heinzel, Richard Fitter and John Patslow. Pp. 336 (19 × 11.5 cm), with 153 plates and many drawings all in colour illustrating over 1000 birds. 825 distribution maps. London, 1974. William Collins Sons & Co. Ltd. Price £ 1.50.

A third field guide covering the same area i.e. Britain and Europe should find few buyers, but this compact publication first brought out in 1972 had a second edition in 1973—the year of the book under review—and others assuredly must have followed. The illustrations

are of high standard, as they must if the book is to sell. The two page spread containing all relevant information and distribution maps on one page and illustrations of the opposite page are used—a new and very useful trend in bird books. Immature birds subspecies and other interesting information is provided by smaller illustrations along with the main ones. Notes on each Family and composite groups of birds provide useful information. The distribution maps cover Russia as far east as the Aral Sea, the northern edges of the Sahara bringing into consideration the entire north Africa and to the east Iraq and western Iran. On the west the coverage extends to the edge of NE. Greenland and to the north it takes in the Arctic Ocean. Thus this compact book describes very many more species with a considerable number of Indian ones making the book useful for birdwatchers in India. Distribution is shown in yellow for summer, blue for winter and green for all the year round occurrence. The slight weakness apparent is in the illustrations of shorebirds, the colours are not quite true. Despite this slight drawback here is a book to be commended to birdwatchers in India. For British birdwatchers an additional set of maps showing status of British birds is provided.

L.J.K.

9. BIRD GUIDE OF THAILAND. By Boonsong Lekagul and Edward W. Cronin, Jr. Pp. 271 (19.5 × 13 cm), with 87 coloured plates, 6 black-and-white photographic plates and a map. Bangkok, 1974. Association for the Conservation of Wildlife. Price $ 7.50.

It is indeed remarkable that a fully illustrated guide should have been produced for a small country like Thailand while in India it is not easy to bring out even major works. The book under review is in its second edition!

For the greater part treatment is in the two page spread type and point markers for salient field identification marks are used. The drawings though not up to the standard one has come to desire after using the European guides, are surprisingly well drawn and well reproduced. A particularly impressive fact is that they have been all prepared by Dr. Boonsong Lekagul himself.

The distribution maps merely indicate by dots the location where collections have been made. This speaks volumes for the modesty of the authors in frankly stating the exact extent of knowledge regarding the status of individual species. This quality again reveals itself in the mention made to other important works for nearby countries, namely the reference to the HANDBOOK OF THE BIRDS OF INDIA AND PAKISTAN by Sálim Ali and Ripley. The introductory chapter on Thailand provides useful information on that fascinating kingdom. Of the 800 species dealt with a large number are of interest to us in India because they are either found all over the subcontinent or are a colourful section of the avifauna of the Eastern Himalayas and the hills on the Indo-Burmese border. It is worth noting that every species has a Thai name.

L.J.K.

Miscellaneous Notes

1. FAT DEPOSITION IN RAT-TAILED BATS (*RHINOPOMA* SP.) IN RAJASTHAN, INDIA

In *Rhinopoma*, as in some other bats, a remarkable degree of fat deposition occurs seasonally in the posterior part of the abdomen and in the interfemoral membrane. Adults of *R. microphyllum* (Brünnich) obtained in January (Malarna Dungar, Sawai Madhopur dist., 8-i-75), July (Maroth, Nagaur dist., 17-vii-73) and November (Ransi, Jodhpur dist., 24-xi-72) had heavy fat deposition. The Maroth females (July) were pregnant. Adults obtained in September (Jodhpur, 27-ix-74; Pali, 28-ix-72; Lohargal, Sikar dist., 26-ix-73) were thin and had little fat. Similarly, individuals of *R. hardwickei* collected in January (Ajmer, 1-i-75), June (Salawas, Jodhpur dist., 26-vi-74) and July (Solyan, Nagaur dist., 17-vii-73) were extraordinarily fat, while those obtained in September (Lohargal, Sikar dist., 26-ix-73) and November (Kalyanpur, Barmer dist., 19-xi-72) were thin and with little fat. Females obtained in June were pregnant, the single female of July was nursing a young one. In both species the fatty areas were hairless.

Except in the breeding season and in winter, fat deposition is negligible. Brosset (1962)[1] concluded in *R. hardwickei* that the process of fat deposition appears to be a seasonal phenomenon and also varies geographically. Thus examples obtained in Ahmedabad in November were very fat while those collected in June were thin. Again the November bats in Ahmedabad were very fat while those collected at Badami about 1000 km further south were thin. The same phenomenon was also noted by him in *T. kachhensis*.

In Rajasthan examples, specimens obtained by me in January, June and July were very fat, while those obtained in September to November were thin. Thus the seasons for fat deposition seem to vary. The young and subadult do not show fat deposition. According to Brosset (1962), *Rhinopoma* species do not hibernate in the true sense but I noticed that both *R. microphyllum* and *R. hardwickei* obtained in January were very lethargic and did not fly away when disturbed. On the other hand they fell to the ground with a thud when released and remained for few minutes before again flying away.

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Y. P. SINHA

DESERT REGIONAL STATION,
ZOOLOGICAL SURVEY OF INDIA,
JODHPUR,
April 3, 1975.

[1] BROSSET, A. (1962): The bats of central and western India. Pt. 1. *J. Bombay nat. Hist Soc.* 59(1): 1-57.

2. BEHAVIOUR OF THE FEMALE OF *TAPHOZOUS MELANOPOGON* (TEMMINCK) AFTER PARTURITION

Taphozous melanopogon lives in colonies of about 100 to 500 specimens. The species is common in and around Bhubaneswar, Orissa, India, and inhabits old temples and caves.

While studying the breeding habits and associated phenomena in this species, some interesting observations were made regarding the behaviour of the female trying to recover its accidentally separated young.

Taphozous melanopogon (Khaparde *in press*) breeds once a year in a restricted period, bringing forth a single young during each cycle. The embryo is borne in the right cornu of the uterus. Pregnancy commences from about the third week of January. Parturition occurs between the 20th of May and 10th of June.

Out of seven females collected on 2-vi-1974 from an old temple at Bhubaneswar three had delivered each carrying a single young attached to the breast, while four others were at an advanced stage of pregnancy. The specimens were caught by a large butterfly net attached to a bamboo. The specimens were then transferred into small collection bags. While keeping the specimens in the collection bags, one of the females with a newly born young attached to the breast escaped and attached herself to the wall of the temple. The young lost its hold on the mother, and fell on an adjacent projection on the wall of the temple. The young made chirping noise, which the mother answered similarly and moved towards and around the young to recover it.

The young one could not get hold of the mother inspite of the various attempts made by the mother to recover it.

Another female which was also carrying a newly born young attached to the breast was released by me to observe if it would help the previous female in any way. The second female remained attached for sometime to the wall of the temple at a close distance from the first female. Then it flew into the temple. After sometime the first female which had lost her young also flew into the temple. The young bat was collected and preserved in 10 per cent formalin.

Gopalakrishna & Madhavan (1971) while studying parturition in *Pipistrellus ceylonicus chrysothrix* stated that, "In a few cases freshly delivered young had accidently dropped from their mothers, sometimes with the umbilical cord and the placenta attached. The mothers do not make any attempts to recover such young."

Similar observations were made by Anand Kumar (1965) about *Rhinopoma kinneari,* in which he observed that, the mothers do not retrieve the young if they fall to the floor during parturition.

Observations of Gopalakrishna & Madhavan (1971) and of Anand Kumar (1965) are of females which lost their young during parturition, whereas the present observations on *Taphozous melanopogon* concern a female which had already delivered before it was caught.

The above observations on *Taphozous melanopogon* show that the mother does makes efforts to recover the separated young if it is nearby and calls.

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April 8, 1975.

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3. A NOTE ON THE BREEDING OF THE INDIAN FOX (*VULPES BENGALENSIS*) IN CAPTIVITY

The mating of a pair of Indian Fox (*Vulpes bengalensis*) was observed twice on 7-ii-75 and once on 8-ii-75 at Nandankanan Biological Park, Orissa. They mated just like domestic dogs and remained tied for several minutes. During copulation either they remained standing or the female moved pulling the tied male along. This female gave birth to four female cubs on 30-iii-75 after an observed gestation period of 50-51 days. The young measured 18.5 cm to 19 cm including the tail length of 5.5 cm to 6 cm and weighed 52 to 65 gm. The eyes of all the four cubs were closed at birth. As the mother rejected the young, all the young died within 24 hours of birth. The female weighed 2.4 kg and the male 2.6 kg on 1-iv-75.

This species mates from November to January and has 4 young, born from February to April (Asdell 1964). According to Prater (1971) the main breeding season is cold weather, cubs usually four in number are born between February and April and the period of gestation is about 51-53 days in the fox.

L. N. ACHARJYO

VETERINARY ASSTT. SURGEON,
NANDANKANAN BIOLOGICAL PARK,
P.O. BARANG, DIST. CUTTACK.

R. MISRA

WILD LIFE CONSERVATION OFFICER,
OLD SECRETARIAT BUILDINGS,
CUTTACK 1 (ORISSA),
April 25, 1975.

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4. A NOTE ON A POPULATION OF *GAZELLA GAZELLA BENNETTI*

Although various species of gazelle have been studied in Africa and Russia (Heptner *et al.* 1966; Walther 1968), the chinkara or Indian gazelle has so far received little attention, the accounts by Stockley (1936) and Prater (1965) being typical of the available information. Between October 1970 and October 1974, I spent about 3 months observing Punjab urial (*Ovis orientalis punjabiensis*) in the Kalabhag Reserve at the western end of the Salt Range in Pakistan (see Schaller & Mirza 1974). While searching for urial along the base and the foothills of the range, chinkara were sometimes encountered. Intermittent hunting has made the animals so shy that they were difficult to observe. On seeing a person the gazelle either gave a series of snorts and then spronked away in their peculiar bounding gait, or they watched the approach silently and alertly while partially hidden behind grass or brush. During the heat of the day, which often exceeded 40°C, chinkara retreated into dense cover from about 0900 to after 1600 hours. Thus, in most instances I merely classified each animal into one of several categories: adult male (24+ mos), yearling male (12-24 mos), female (12+ mos), large young (6-12 mos), and small young (0-6 mos). Males were considered adult when their horns had the typical S shape and were some 25-35 cm long. (One adult male had horns of 28 cm, a total length of 124.5 cm, tail of 14.5 cm, ears of 14.5 cm, shoulder height of 67.6 cm, and weight of 23.4 kg). Yearling and adult females could not always be distinguished with precision and the two age classes were therefore lumped.

About 75 to 100 chinkara frequented some 7.5 sq km of flat to undulating terrain broken by stony ravines and covered sparsely with *Acacia modesta, Salvadora oleioides, Zizyphus nummularia* and other shrubs and trees characteristic of an environment with an annual precipitation of about 40 cm, most of it from July to September. However, gazelle habitat extends in all directions, and animals could wander freely into and out of the study area. A total of 601 gazelle were classified, some repeatedly in the course of the study. The population tally included 22 per cent adult males, 3 per cent yearling males, 61 per cent females, 10 per cent large young, and 4 per cent small young. There were 40 males to 100 females. This low proportion of males is caused not only by selective sport hunting but probably also by the emigration of yearling males from the study area. Young animals were surprisingly scarce, 23 young to 100 females. However, the non-breeding yearling females are included in this computation. I saw no evidence that one-year-old females took part in the rut. It seems likely that young females conceive at about 18 months of age and have their first young some $5\frac{1}{2}$ months later. Though predators are rare, a few newborns are no doubt killed by village dogs, foxes, jackals, and raptorial birds. Prater (1965) stated with regard to chinkara that "they have no particular breeding season." Heavily pregnant females and newborn young were most often seen in April at Kalabagh. I also found a newborn, still damp and crouched motionless among tufts of grass, on October 19, another on November 3, and also saw several tiny youngsters following their mothers during these two months. The evidence indicates that these chinkara have a discrete major birth peak in April and a minor one in the autumn. One young per adult female per year seems to be the rule; however, on two occasions a female had two young of the same age at heel.

4

According to Stockley (1936), herd size in chinkara ranges from 2 to about 10 with 23 being the largest herd he recorded. Of the animals at Kalabagh, 29 per cent were alone, 28 per cent in groups of 2, 13 per cent in groups of 3, 10 per cent in groups of 4, 5 per cent in groups of 5, 10 per cent in groups of 6 to 10, and 5 per cent in groups of 11 to 14. One group, observed outside the study area, comprised 25 individuals, among them 4 adult males and 2 yearling males. Average group size including solitary animals was 1.9, and excluding them 3.0. The basic social unit is a female and her offspring, an association that may persist for at least 12 months, until she has another young. Several females and young often joined, as did several males on occasion. An adult male and female were seen together 27 times, half of the instances during the main rut in autumn. Herd structure changes somewhat with the seasons, as these figures for solitary animals show:

Month	% females alone (or with a young)	% adult male alone
April	34	72
July	23	53
Oct.-Nov.	39	43
Dec.	24	30

The differences are in part related to the breeding cycle. Adult male chinkara are often territorial, as are males of all gazelle species (Walther 1968), in that they may remain for long periods on a small plot of ground from which they chase other males but attempt to retain visiting females. In April, when few females come into oestrus, males tend to be alone on their territories, whereas in October-November they have often been joined by females. Females were most often alone during months when they gave birth and when herds disbanded prior to rutting. A major reorganization of chinkara society occurred in December when many males left their territories and females congregated. Clusters of 10 to 20 chinkara, the animals close to each other but not necessarily in a discrete herd, were commonly seen.

The behaviour of males on their territories and when courting is much like that of Thomson's gazelle, *Gazella thomsonii* (*see* Estes 1967; Walther 1968). Each territory seems to be 200 m or more in diameter and is demarcated by several fecal stations which the male uses repeatedly. On visiting a fecal pile, the male typically sniffs it, paws a few times a foreleg, then stands erect with his legs extended forward and back as he urinates, and finally squats deeply and defecates. I have often seen Thomson's gazelle mark grass stalks with the black secretions from their pre-orbital glands. This behaviour was not observed in chinkara, but the musky-smelling black fluid in their glands is no doubt used for such marking too. When approaching an oestrus female, the male may walk in a slightly crouched position with muzzle stretched forward or somewhat raised. If she flees, he may chase her, grunting. Sometimes he stands motionless behind her, nose stretched high in a head-up display, until she runs away, he in close pursuit as they circle bushes and patches of grass, their tails flicking. One male lightly kicked a female with a stiff foreleg between the hind legs, a common courtship gesture among antelopes. Attempted mounting were seen on two occasions. On one of these, a male mounted briefly 47 times in 8 minutes but without success as the female continued to trot slowly. Out of 8 instances of courtship behaviour observed, 7 occured in October-November and one in April.

The work was financed by the New York Zoological Society and National Geographic Society, and it was sponsored locally by World

Wildlife Fund–Pakistan. I am greatly indebted to Malik Muzaffar Khan, the Nawab of Kalabagh, for permission to observe wildlife in his reserve.

New York Zoological Society,
Bronx Park, New York,
July 7, 1975.

GEORGE B. SCHALLER

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5. THE DUGONG *DUGONG DUGON* (SIRENIA) AT BAHRAIN, PERSIAN (ARABIAN) GULF

The Dugong *Dugong dugon* is listed by the International Union for Conservation of Nature and Natural Resources (IUCN) as an endangered species. With the formation of the Sirenia Specialist Group of the Survival Service Commission of the IUCN (Bertram 1974) further emphasis has been given to the general concern felt for the future of the dugongs and manatees, and to the need for more information on which to base protective measures. G C L & C K R Bertram (1973) review the present state of knowledge of this group of aquatic herbivores and they mention my collection of skulls of *D. dugon* from the Persian (Arabian) Gulf. This note is to place on record some details of this collection, which is now deposited in the British Museum (Natural History), London.

The 30 small islands of Bahrain lie in the Gulf of Bahrain at the entrance to the Gulf of Salwa, midway along the southern coast of the Gulf at 26°02′N. 50°32′E. They form part of a narrow, uplifted structural feature, known as the Bahrain Ridge, over which the water depth is less than 9 metres. Apart from rocky reefs, the sea bed around Bahrain and in the Gulf of Salwa consists of sands or muddy sands (Purser 1973). Short sea grasses, available to the Dugong as food (listed by Newton 1965), are quite abundant, though patchy; they are more common on the sheltered east side of Bahrain, particularly near the flume, or outlet of cooling water, of the BAPCO oil refinery at Sitra.

My observations are of animals cast up dead on the shores of Bahrain Island in 1969, 1970 and 1971, and of remains found there and on Howar Island, 13 miles to the south-east. The cause of death was never apparent, but may include drowning in fish traps and nets, ingestion of oil, concussion from sub-marine seismic surveys (such as those carried out in 1971) and natural causes, particularly during the coldest months of January and February.

The animal is known to some Bahrainis as *Baqarat al Bahr* (sea cow), and to some others as *Baqara seit*, but for the only reports of live animals I am indebted to the late Mrs Anne Khalifa and to Mr. J. H. Clingly, who have observed single specimens as recently as 1974 off the east coast of Bahrain Island, swimming and surfacing "like a slow dolphin"; and to Mr R. Pickersgill, who once saw one raise its head and shoulders above the surface. From this evidence and the list of specimens which follows, one may conclude that a small population continues to survive in the Gulf of Bahrain. I am grateful to Dr G C L Bertram for criticising a draft of this note.

C/o LLOYDS BANK LTD.,
6 PALL MALL, LONDON SW1Y 5 NH,
June 23, 1975.

SKULLS OF *D. dugon* FOUND AT BAHRAIN

14 Apr 1969	♂	E. coast, near Askar.
27 Apr 1969	♂	Ras al Bahr.
1969	o?	Ras al Bahr.
29 Apr 1970	♀	E. coast, near Durr.
29 Apr 1970	♂	E. coast, near Durr.
22 Feb 1970	o?	Ras al Bahr.
10 Feb 1971	♀	E. coast, near Ras al Qarain

A skull from the remains of an animal dead about 3 months.
An old skull.
An old skull.
Skull from a carcase, length *c.* 7 ft, reported dead 22 February 1970.
With the ♀ above; length 9-10 ft.
An old skull.
Whole head [in deep freeze in the BM (NH)] from a freshly dead, fully fed animal, length 83 inches.

M. D. GALLAGHER

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6. THE OCCURRENCE OF RUSSIAN-RINGED LARGE CORMORANTS [*PHALACROCORAX CARBO SINENSIS* (SHAW)] IN INDIA

In the afternoon of 15th January 1975, I was out rowing at the Boat Club at Calcutta. Hundreds of Little Cormorants [*Phalacrocorax niger* (Viellot)] were settled on the trees on the island in the centre and as we approached it, four Large Cormorants [*P. carbo sinensis* (Shaw)] were seen perched high up. An examination through glasses, revealed that one of them carried a ring on its leg, the ends of which were not folded over each other as is usual, but projected behind like a spur, as illustrated on the cover of current numbers of *The Ring*.

Inquiry at the Bombay Natural History Society failed to reveal any evidence of such rings having been used in India, but there was one record of a Large Cormorant ringed near Alma-Ata 43° 15′N., 76° 57′E. Khazakhastan, U.S.-

S.R. on 30th May, 1973 being recovered in Gharuan village, Ropar District, Punjab. The original correspondence is not traceable and it is not possible to determine what kind of ring was obtained.

A letter to Dr. W. Rydzewski, Editor of *The Ring*, Laboratory of Ornithology, Wroclaw, Poland, was passed on to Dr. E. Gavrilov, Institute of Zoology, Alma-Ata, who confirms that rings with such fasteners have been used in Khazakhastan, and that eight recoveries from or near (1) Ghaziabad, (2) Sagar Lake, Jodhpur, (3) Udaipur, (4) Gorakhpur, (5) Delhi, (6) Agra, (7) Dimna Lake, Jamshedpur, and (8) Sachors (?) Dist, Bihar, have been reported to the Ringing Centre at Moscow.

A paper on the migrations of *Ph. carbo* in Kazakhastan, has, I am told, been completed and will be published next year. Birdwatchers and sportsmen in India may well keep a look-out for additional specimens, in which through binoculars, the ring is very prominent in birds perched out of water.

HUMAYUN ABDULALI

FAIZ & CO.,
75, ABDUL REHMAN STREET,
BOMBAY 400 003,
April 22, 1975.

7. SOME OBSERVATIONS ON THE EGGS OF THE GREAT WHITE-BELLIED HERON, *ARDEA INSIGNIS*

The Great Whitebellied Heron *Ardea insignis* Hume (ex Hodgson) is a little known species occurring in swamps, marshes and forests from Nepal through Sikkim, Bhutan and N.E. Assam to Bangladesh, Arakan and North Burma. Only four eggs appear ever to have been taken, all of these being in the collection of the British Museum (Natural History). They all came originally from the Stuart Baker Collection, but one egg was apparently given by Baker to J. Davidson and reached us with the latter's collection. The eggs are two and two, two from Sikkim and two from Arakan, the Sikkim eggs being markedly smaller than the others, and for this reason were not accepted as genuine by Baker; they do not appear in the manuscript catalogue of Baker's collection, and it was one of these two which Baker gave to Davidson. These two were addled eggs taken from two separate heron's nests each of which also contained two chicks (Baker 1929), which fact might explain their small size. The Arakan eggs were two from a set of four and were on the point of hatching. One egg (the larger) is partially broken and filled up with wax. They were collected by a Mr W. S. Thom and given to J. C. Hopwood who passed them to Baker. It is not recorded what became of the other two eggs in the clutch. The measurements of the eggs are as follows:

Sikkim eggs: 63.0×42.9 and 63.1×41.65

Arakan eggs: 69.0×49.7 and 72.2×50.9

It would be unusual, but by no means impossible for the two pairs of eggs collected to have come from the extremes of the species' normal size range. To ascertain what range might be expected I compared the eggs of *A. insignis* with the normal range for *Ardea cinerea*, as given by Witherby *et al.* (1940). The range for *A. cinerea* is 53.5-66.7 and 40.0-49.7. It will

be seen therefore that the difference in size of the two lots of eggs of *A. insignis* is no greater than the normal range of *A. cinerea* and therefore the size difference is not, in itself, a valid reason for rejecting the Sikkim eggs.

No other large heron is known to breed in Sikkim. Sálim Ali (1962) lists only one possibility, *Ardea goliath,* which may occur as a vagrant, but is not recorded as breeding anywhere within the Indian sub-continent. Therefore, if the Sikkim eggs of Baker's are *not* the eggs of *Ardea insignis* they are the eggs of some other species of heron hitherto unrecorded from Sikkim.

MICHAEL WALTERS

British Museum (Natural History),
Cromwell Road,
London, S.W.7,
January 30, 1975.

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8. PEACOCKS AND COBRA

A common belief is that peacocks and snakes are mortal enemies. How far the peafowl is dangerous to large snakes may be a moot point but instances of sighting of snakes and peafowl engaged in mock fights are not uncommon.

One evening sitting behind a bush at the Forest Plantation of *Acacia arabica* near our College, I and some of my friends watched a flock of peafowl drinking water from a puddle on the fringe of the forest. Abruptly one peacock looked up at a nearby tree and started moving watchfully towards the tree. We soon saw a large cobra descending from the tree.

As soon as the cobra landed on the broken black soil two peacocks 'escorted' it on either side.

The snake made its way passively but the peacocks occasionally pecked at the cobra gently and to this the reptile responded by raising its hood. The peacocks were wary, and whenever the cobra raised its hood they stood alert with raised hackles. As the cobra started gliding, the peacocks pecked at it and always the cobra reacted. The birds did not attempt to kill the snake, they just teased it.

This behaviour continued nearly for a hundred feet but nearing a thorny bush the snake vanished into a hole and the peacocks returned to their harems.

A. J. T. JOHNSINGH

Ayyanadar Janaki Ammal College,
Sivakasi,
January 30, 1975.

9. THE ROOSTING HABITS OF GREEN BEE-EATER, *MEROPS ORIENTALIS ORIENTALIS* LATHAM

Green bee-eater, a little insectivorous bird is found all over the open cultivated plains in India, except in Eastern Assam (Sálim Ali & Ripley 1970).[1] This bird is seen throughout the year in Poona, roosting communally on different green foliage trees. Fourteen such roosting sites were observed in and around Poona. One particular roosting site was selected for intensive observations on pre-roosting and post-roosting behaviour, timing, display flights, population counts and feeding habits.

These birds arrive in pairs or small heterogenous flocks at the roosting place; their time of arrival is normally associated with sunset. Those birds which reach before sunset show pre-roosting behaviour around the roosting place. For instance some birds from pre-roosting perches make flights high into the sky in groups calling and then suddenly all return to the perches. The birds arriving after sunset go directly to the roost. The time of arrival of the birds is early during cloudy days than on clear days. The time taken for assemblage during cloudy days is also more (30-45 minutes) than on clear days (15-20 minutes). At roosting time a typical high pitched warning signal is given by the birds in case of danger from intruders (Black Drongo, Cuckoo, Crows or birds of prey) when all the birds fly off and return to the roost only when they are sure that the intruder has left the site. In a few instances the birds were seen in large numbers to chase away the intruder. Sometimes when the roost is disturbed, some birds of the main roost form another roost and in the morning they rejoin the original roost. The roosting site is shifted if repeated disturbance occurs, and in due course they return if the disturbances stop. The birds do not favour mixed roosting with any other bird.

In the morning about 30 minutes before sunrise, the birds start dispersing from the roost and leave in batches of 5-30 birds. On cloudy, rainy or winter mornings the dispersal is delayed. The number of roosting birds vary, in general it increases towards the winter.

The food of the birds consists of fast flying insects, caught by darting after the prey. The prey is either battered against the perch or crushed in the beaks moving the head in circular fashion and swallowed. Feeding activity is less during noon time when they rest on trees. Towards evening the feeding increases till the bird goes to the roost. They normally feed in an area about 2 km in radius of the roosting place. The Bee-eater is occasionally seen on the back of buffaloes in the company of cattle egrets feeding on the insects around. However, if a Black Drongo happens to be around it chases away the smaller bee-eater.

ZOOLOGICAL SURVEY OF INDIA,
WESTERN REGIONAL STATION,
POONA 411 005,
June 12, 1975.

D. B. BASTAWDE

[1] SALIM ALI, & RIPLEY, S. DILLON (1970): Handbook of the Birds of India and Pakistan, Vol. 4. Oxford University Press, Bombay.

10. WESTERNMOST RECORD OF THE GREAT SLATY WOODPECKER *MULLERIPICUS PULVERULENTUS* IN HIMACHAL PRADESH

This fine and distinctive woodpecker is stated to be found in the Himalayan foothills from Kumaon *c.* 79° E through Nepal to Sikkim and Bhutan (p. 206, Vol. 4 of HANDBOOK). In 1950 I had the good fortune of staying for a considerable time in Simla and I have done the hills around that hill station more thoroughly than possibly any one else could hope to. The northern slopes of Jakho Hill (*c.* 77°E) above the circular cart road is covered with very dense stands of *Rhododendron arboreum*, and there was a lot of undergrowth. Quietly walking through this forest, pausing every now and then to locate birds busy with their various activities, I noticed a large woodpecker alighting at the base of a tree. The bird was not more than fifteen feet from where I stood and seemed totally oblivious of my presence. I was able to watch it through my field glasses for more than half an hour! It first hunted around the tree trunk and then slipped down onto the ground and began to feed on ants giving me excellent views of it from all sides as it busily and with great concentration fed on the insects. What struck me was the large size, the distinctive slaty grey colour and crimson moustache stripes which later sexed my bird as a male. All the while that the bird performed for my benefit, it remained silent. Finally he flew down the mountain and I went my quiet way up. So clear and distinctive this view had been that even today I can visualise the bird and the reason why I did not write earlier about its westward range extension was the fact that I identified my bird from the same illustrations with Shivrajkumar and it never occurred to me that the bird was not found all along the Himalayas.

I saw the bird in June and at an altitude a little above 7,000′.

LAVKUMAR J. KHACHER

C/o. WORLD WILDLIFE FUND,
HORNBILL HOUSE,
SHAHID BHAGAT SINGH ROAD,
BOMBAY 400 023,
January 10, 1975.

11. THE GREYHEADED MYNA NESTING IN RESIDENTIAL BUILDINGS

In 1970, when studying breeding biology of the House Sparrow *Passer domesticus* Linnaeus for my M.Sc. dissertation, I saw five pairs of the Greyheaded Myna *Sturnus malabaricus* (Gmelin) building their nests inside ventilator holes of a residential hostel of the University of Dacca, situated in the heart of Dacca city (Bangladesh). The nests of the Greyheaded Myna were found only in the ground floor holes of the three storied structure. There were 53 such holes, and of these, 5 were occupied by the Greyheaded Myna, one by the Common Myna *Acridotheres tristis tristis* (Linnaeus) and the remaining ones by the House Sparrow. The holes were located at a height of about 5 metres (15 ft). In March 1970, the Greyheaded Mynas sometimes fought with the House Sparrows over holes which were already under

possession of the latter. The Greyheaded Myna also frequently entered the nest holes of the House Sparrows. This occasionally led to fights between the sparrows and the mynas in the bid of the sparrows to save their nests. The Greyheaded Mynas nested and brought up young during April-May, 1970. In the year 1972 three nests were found in the same habitat.

The HANDBOOK *5* [Ali & Ripley (1972)] does not mention residential buildings as a nesting site of the Greyheaded Myna.

MD. ALI REZA KHAN

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BOMBAY NATURAL HISTORY SOCIETY,
HORNBILL HOUSE, SHAHID BHAGAT SINGH RD.,
BOMBAY 400 023, INDIA,
January 20, 1975.

12. THE BANK MYNA (*ACRIDOTHERES GINGINIANUS*) IN BOMBAY

The first breeding record of the Bank Myna (*Acridotheres ginginianus*) for Bandra, Bombay suburb, was published in this *Journal*, *51*(3):736, in 1953. Since then these Mynas were breeding in the same disused old well every year regularly between March and August till 1972. The number of birds remained between three or four pairs and ten pairs at the maximum. Due to the construction of a huge multi-storeyed building over the well, the birds were forced to leave the nesting site in 1973 and their whereabouts since are unknown. The persistence of this small breeding colony over the past twenty years, and only at this one particular place in Bombay, seems a most interesting and remarkable circumstance, worthy of putting on record.

More recent information concerning the occurrence or breeding of this species in Greater Bombay or its outskirts since 1972 would be welcome. This locality is stated to be the southernmost limit of the birds range in W. India. (IND. HANDBOOK, Vol. *5*:181).

V. C. AMBEDKAR

174 KASBA PETH,
POONA 411 011,
March 17, 1975.

13. OCCURRENCE OF ABBOTT'S BABBLER, *TRICHASTOMA ABBOTTI* (BLYTH) IN ORISSA

While working out a collection of birds from Orissa present in the Zoological Survey of India, I found a male specimen of the Abbott's Babbler, *Trichastoma abbotti* (Blyth) (Muscicapidae: Timalinae), collected on 24 January 1974 from Balugaon, Puri district, Orissa, by Dr. V. C. Agrawal. Its measurements (in mm) are—wing 74, bill from skull 22, tail 48.

Standard literature on Indian avifauna like Baker (1922), Ali & Ripley (1971) does not include Orissa in its range. The present example, therefore, serves as the first record of its occurrence in Orissa.

ZOOLOGICAL SURVEY OF INDIA,
CALCUTTA 13,
April 6, 1975.

J. M. DASGUPTA

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14. FAECAL FEEDING IN THE WHITEHEADED BABBLER *TURDOIDES AFFINIS* (JERDON)

The Whiteheaded Babbler breeds in the campus of the Madras Christian College, Tambaram, Tamil Nadu, during the months of September-October as reported by Sanjeevaraj (1964). The condition and behaviour of the hatched out chicks in this species is typical of the birds categorised as altricial. The object of the present note is to draw attention to the report of the observation, made perhaps for the first time, of a particular behaviour during chick rearing in this species, and to offer a new line of reasoning of its significance.

Observing a nest of the Whiteheaded Babbler through binoculars, it was noticed that the adult bird which fed the young, picked the faecal sac as it was being extruded by the chick and swallowed it before leaving the nest on another trip for food. The faecal sacs were oblong in shape and in colour, whitish for the most part, with a black end that came out last. This and other observations were reported by me (Jeyasingh 1975) in a detailed article published elsewhere.

Lanyon (1964) states that such eating of the faecal sacs in some of the altricial birds such as the Jay and the Canary is to provide for nest sanitation. However, an alternate line of reasoning seems more probable. The faecal matter of the chicks of such altricial birds probably contains some nutrients that are needed by the adult. Hence, this kind of faecal feeding may have more to do with the nutritional physiology of the bird than to its sense of sanitation. Further work to check on this line of reasoning is in progress.

CURATOR,
MADRAS CHRISTIAN COLLEGE,
TAMBARAM, MADRAS 600 059,
March 14, 1975.

D. E. J. JEYASINGH

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15. ON A NESTING PAIR OF TAILOR BIRDS (*ORTHOTOMUS SUTORIUS*)

On 11-vii-1973 a newly started nest of the Tailor Bird was found in my backyard in Trivandrum, Kerala State. It was completed on 15-vii. The first egg was laid on 17-vii, and two more eggs, laid at twentyfour-hour intervals, completed the clutch. One of the eggs hatched on 31-vii before 0658 hrs, another some time between then and 1410 hrs on the same day, and the third some time before 1400 hrs on 1-viii. All three nestlings left the nest on 13-viii, one by one, at 0655, 0805, and 0815 hrs.

Assisted by two of my grown-up children, I watched the nest for a total period of 128 hours through doors and windows 1.5 to 3 metres away. On 6 days (21-vii, 31-vii, 3-viii, 6-viii, 10-viii and 12-viii) a dawn-to-dusk watch was maintained. Details of behaviour were noted down on the spot.

Some of the more interesting observations are given below[1]:

1. Although the male was seen carrying a few down-feathers towards the nest, once on 10-vii- and once on 12-vii, only the female was seen at work on the nest. On no other occasion was the male found bringing nest material. The discovery of the nest was due to the fact that at 0930 hrs on 10-vii the male was seen offering a few tiny, white down-feathers to the female who was behaving like a juvenile begging for food. Instead of putting the feathers into her mouth, the male flew down towards the nest. No other incident suggestive of courtship-feeding was noted.
2. During nest construction most of the work was done between 0730 and 0900 and again from 1530 to 1630 hours.
3. On 16-vii (the day before the laying of the first egg) no bird was seen near the nest at any time.
4. After laying the first egg the female never visited the nest on that day.
5. The second egg was laid between 0635 and 0638 hrs on 18-vii. The nest and eggs were left alone till 1840 when, for the first time, the female came to sleep in the nest.
6. The male took no part in incubation, nor did he ever feed the incubating female.
7. The period between the laying of the first egg and the hatching of the first nestling was 14 days (*c.* 336 hours); that between the commencement of incubation (presuming that incubation started at 1840 hrs on 18-vii when the female settled down in the nest for the night) and the hatching of the first chick was 12.5 days (*c.* 300 hours). However, the way the female was sitting suggested that the two eggs then in the

[1] Details of nest-structure will be dealt with in another note.

nest need not have been in contact with her body. She was sitting high up in the nest, rather like a lid, and had not pressed herself down as was her practice on subsequent nights. Regular incubation definitely began in the morning on 19-vii.

8. During the incubation period, periods of incubation and of absence from the nest more or less balanced each other. The dawn-to-dusk observations of 29-vii showed that:
   (a) between 0635 and 1750 hrs the female brooded 25 times (average duration 13.68 mins).
   (b) between 1200 and 1300 hrs periods of incubation and absence were both very brief (maximum in both cases 6 mins).
   (c) between 0635 and 1138 hrs the average duration of incubation was 15.5 mins, and of absence 16.5 mins; between 1306 and 1750 hrs these were 18.2 and 13.1 mins respectively.
9. The female brooded the nestlings frequently in the day-time during the first four days after hatching. The last instance of diurnal brooding was of 16 minutes' duration (1740 to 1756 hrs on 3-viii), but she continued to sleep in the nest for 5 more days.
10. The female spent the night in the nest on 22 days, 9 of which were after the eggs had hatched.
11. Both male and female began feeding the young regularly soon after the first egg hatched. On the first day, however, it was the female who did most of the feeding. On the whole, male and female shared the task of feeding equally. The average number of feeding trips, based on the observations of 90 hours, are: male 6.34 times, and female 6.88 times per hour.
12. Between 2-viii and 13-viii, on 8 days the longest interval between 2 feeds occurred in the afternoons; on 5 days it fell between 1700 and 1800 hrs. On the last two afternoons (11-viii and 12-viii) it was between 1420 and 1500 hrs.
13. Feeding frequency increased with the age of the nestlings. From 113 times on 3-viii, it rose to 233 times on 2-viii.
14. Only twice or thrice were the parents seen consuming the food brought for the nestlings. This was always in a context of disturbance by human presence. More often, however, even when people were present, the parents would wait till the coast was clear or, overcome by the feeding urge, go and feed the young. On 12-viii and 13-viii the male was the first to come and feed the chicks in the morning (at 0614 and 0621 hrs respectively). The first feed of the day did not involve any special display.
15. Both parents attended to nest sanitation; but the male was seen carrying away faecal sacs more often. There was no rhythm or pattern in the voiding of faecal sacs. At times a number of visits would pass without the appearance of a sac, while sometimes parents would be removing a sac on each of two or three consecutive visits.
16. Although male and female had favourite routes to and fro, when transporting faecal sacs they flew off in many different directions. This should have helped distribute the conspicuous white globules over a wide area, preventing a clear trail from developing and so guiding a predator to the nest.
17. What the parents did with the faecal sacs could not be discovered. Just once an adult was seen thrusting a faecal sac into the gap between two roof-tiles about 10 metres

away from the nest.

18. The adults never indulge in any sort of distraction display.
19. The behaviour of this breeding pair suggested that they had little territorial sense.
20. Nine minutes after the last of the 3 nestlings had left the nest, the female came to the nest with a small grasshopper. After looking many times at the nest, she flew off still carrying the insect. Three minutes later she came again with food, alighted on a plant 1 metre away, looked at the nest and flew off. At 0939 hrs she came once again with food, alighted close to the nest and soon flew off.
21. The nestlings were quite silent as a rule till the day they left the nest. But on 4-viii one uttered a feeble *cheep-cheep* when the parent was leaving after a feeding trip. The next time a chick was heard calling was at 0614 hrs on 13-viii, when one had slipped through an opening at the back of the nest and was clinging on the outside. It uttered a low *chweek*. Then, at 0620, for the first time a chick was heard responding to an adult's call with a low *chweee*.
22. One of the most surprising and exciting incidents occurred on 7-viii. I happened to press the nest at a point 4 or 5 cm below the rim of the nest-cup. At once there came a loud, frighteningg rasping hiss from within the nest. When other parts of the nest above and below this point were pressed no such response was elicited. But every time pressure was applied to this part of the nest, the young (only one at a time apparently) hissed.
23. This pair of Tailor Birds did not subject their fledglings to a 'hunger period' in order to induce them to leave the nest. Only the last of the fledglings to leave the nest had to be lured out of the nest by the offer of food from a distance.
24. Even after the first fledgling had left the nest, the parents continued to feed the remaining two for more than an hour without any appreciable change in the frequency of feeding.
25. The nest was not used by the juveniles as a roost after they had flown.
26. The behaviour of this pair of Tailor Birds differed from the account given in the HANDBOOK (1973) in that:
    (a) incubation was solely by the female;
    (b) the male was never seen feeding the incubating female;
    (c) the nestlings were practically silent till the day of their first flight.

I am grateful to Dr Sálim Ali for going through an earlier, over-elaborate draft and offering valuable suggestions and advice.

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REFERENCE

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16. WESTERNMOST RECORD OF THE BLACKFACED FLYCATCHER WARBLER *ABROSCOPUS SCHISTICEPS* IN GHARWAL

During a pilgrimage to Kedarnath and Badrinath, Shivrajkumar and myself did a considerable amount of birdwatching along the pilgrim track. Between Gupta Kashi and Kedarnath (*c.* 79°E) the walk is through very pleasing country and a day's walk can reveal a number of typical middle altitude hill species. Watching a party of small birds among oak and rhododendron along the track we were struck by a pair of distinct but totally unidentifiable flycatcher warblers. They were among the more common, and to me very familiar Greyheaded Flycatcher Warbler *Seicercus xanthoschistos* and what struck us was the black on either sides of the face contrasting with the yellow supercilium and forehead and yellow on the breast. I made a sketch on the spot which later helped me to identify the bird at once on seeing it in some illustrations which Dr Sálim Ali had given Shivrajkumar. The birds were quite fearless and feeding in the lower branches of the trees beside the track at eye level. This record was in May, and our altitude could not have been more than 6,500′.

The western limit given in the HANDBOOK Vol. 8, p. 192, is Central Nepal.

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17. RECORDS OF BIRDS FROM THE ANDAMAN AND NICOBAR ISLANDS

While working out a collection of birds from the Andaman and Nicobar Islands made by Dr. A. K. Mukherjee of this department in 1972, I came across five examples of two species of birds, namely *Charadrius alexandrinus* Linnaeus and *Tringa terek* (Latham), which add to the known distribution of the species.

Charadrius alexandrinus Linnaeus Kentish Plover

1♀; Malaka, Car Nicobar; 19 Feb. 1972.

The Kentish Plover was found in small numbers in company with other waders on the seashore. It often separated itself from the flocks while foraging. The specimen collected measures (mm): wing 107, tail 46, bill from skull 22, tarsus 27 and weighed 35 gm.

In winter, the Kentish Plover visits the Indian mainland over a wide area but there is no report of its occurrence in the Andaman and Nicobar Islands. Thus, the present specimen forms the first record of its occurrence in these islands.

Tringa terek (Latham) Terek Sandpiper

4♀; Malaka, Car Nicobar; 17 Feb. 1972.

The Terek Sandpiper was found in flocks on the sandy shores of the Car Nicobar Island. All the collected specimens were in winter plumage. They had the central tail feathers moulting and had non-breeding gonads. The birds measure (in mm): wing 132, 135(3), tail 51,

52, 53, 54; bill from skull 51, 52, 53(2); tarsus 28, 29, 32(2), and they weighed 66, 64, 72, 70 gm.

Although the Terek Sandpiper is well known in the Andaman Islands, the only record of its occurrence in the Nicobars is based on a sight record by Abdulali (1967, p. 161)[1] on Trinkut Island on 11 March.

These examples, therefore, serve as the first authentic collection of the species from the Nicobar group of Islands, thus extending its winter range further south.

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[1] ABDULALI, H. (1967): The birds of the Nicobar Islands, with notes on some Andaman birds. *J. Bombay nat. Hist. Soc. 64*:139-190.

18. EGG LAYING OF THE MUGGER (*CROCODYLUS PALUSTRIS*) IN CAPTIVITY

The female of a pair of Mugger (*Crocodylus palustris*) at the Nandankanan Biological Park, Orissa laid 27 eggs on the morning of 11-vi-1974. The eggs were white, hard shelled and blunt at both ends. Eleven of these measured 6.7-8.2 cm × 3.7-4.3 cm and weighed from 69 to 80 gm. Unfortunately the mother crocodile was found dead and floating in the tank on 13-vi-74. On autopsy six more eggs were collected from the posterior part of the oviduct. These white, hard shelled eggs measured 6.8-7.2 cm × 3.9-4.2 cm and weighed from 71 to 81 gm. The crocodile measured 142 cm from snout to vent and 132 cm from vent to tip of the tail (Total length 274 cm). However all the eggs were found spoilt when examined after over 3 months of incubation in the sand hole. Probably all were infertile.

David (1970)[1] states that mating of this species takes place in December and January in the water and eggs are laid in March and April in Ahmedabad Zoo. He further states that one female has laid 28 eggs out of which 23 young hatched out on 6-vi-1969 in the same zoo.

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[1] DAVID, REUBEN (1970): Breeding the Mugger Crocodile and Water Monitor—*Crocodylus palustris* and *Varanus salvator* at Ahmedabad Zoo. International Zoo Yearbook, *10*:116-117.

19. NOTES ON THE SKIN SLOUGHING OF RETICULATED PYTHON IN CAPTIVITY

The periodicity of sloughing of skin in the snake is a well known fact and varies according to the sex, age and seasons. It is more frequent in summer and less during the colder seasons. According to Deoras (1965) the inter sloughing period varies usually 72 to 210 days in the snakes. But study of sloughing in Pythons under captivity has shown specific differences in the two species, *Python molurus molurus* Linn. and *P. reticulatus* (Schneider). So far we have not come across of any detailed sloughing record of Reticulated Python. Records of sloughing of this species was maintained continuously for two years at the Nandankanan Biological Park, Orissa.

A female Reticulated Python measuring approximately 1½ metres was procured on 8-iv-69 for the Park. Sloughing of skin of this snake was observed for two years from May 1973 to April 1975. The snake measured 404 cm on 13-viii-73 and later 435 cm with a circumference of 41 cm at the thickest part on 21-i-75. Within this two years period it sloughed 20 times and the inter-sloughing period varied from 22 to 105 days, being longest between 12th November, 1974 to 26th-28th February, 1975. At another time the duration was 56 days from 2nd December, 1973 to 28th January, 1974. Just before sloughing the body colour turns dull and the covering of the eyes becomes milky white. The snake becomes inactive and generally refuses to feed. For the completion of the process sometimes it takes two or three days and the outer epidermal layer is cast off by bits starting from the tip of the nose. After the sloughing the snake looks brighter, becomes active and accepts food.

Further the above measurements show that in 4 years 4 months it grew 254 cm but in the last two years it grew in length only 31 cm. It is interesting that the interval between sloughs was 50 days in the winter of 1974, 105 days in the winter of 1975.

Biswas & Acharjyo in a separate publication which is in press, have observed the inter-sloughing period of two adult *Python molurus* as 37 to 128 and 31 to 97 + ? days respectively. Here also the inter-sloughing period has been noted to be longer in the winter and in the case of a female when it was incubating. The variations of inter-sloughing period is lower in *P. reticulatus* than *P. molurus*.

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20. ON THE FEEDING HABITS OF THE KING COBRA *OPHIOPHAGUS HANNAH* (CANTOR) AT NANDANKANAN BIOLOGICAL PARK, ORISSA

These observations on the feeding habits of two King Cobras *Ophiophagus hannah* (Cantor) were made at the Nandankanan Biological Park, Orissa.

On 20-xi-1973, a dead rat snake [*Ptyas mucosus* (Linn.)] measuring about 157 cm (61 inches) was given to one of the King Cobras measuring about 390 cm (13 feet) at about 9.30 a.m. At 12 noon it bit at the middle portion of the rat snake's body and then slowly shifted its grip towards the head without leaving it completely. It reached the head after 15 minutes and then started swallowing the rat snake, taking another 30 minutes to swallow it entirely, uncoiling itself during the process.

On 19-xii-1973, the same King Cobra was given a live rat snake measuring about 150 cm (c. 6 feet) in the forenoon. The rat snake moved about inside the cage and the King Cobra did not show any interest in it. The vertebral column of the rat snake was struck and the snake immobilised and it was offered to the King Cobra in the afternoon. Then it caught hold of the middle of the body and swallowed it as described above, taking about the same time.

As the other King Cobra measuring 268 cm (8′-9″) had refused to eat a live *Xenochrophis piscator* (Schneider) measuring 81 cm (*c.* $2\frac{1}{2}'$) repeatedly offered to it the previous week, the Keelback was immobilised in the same manner and offered on 27-i-1974. The cobra twice examined the prey with its tongue during ten minutes of our observation but refused to take it and moved away. The Keelback was then killed and offered, and within a few minutes the cobra caught hold of the anterior part of the body and swallowed it in 15 minutes.

Before taking the prey the King Cobra usually examines it with the tongue and its willingness to eat it is indicated by "yawning" once or twice. During the process of swallowing, the upper jaw remains more or less stationery and the lower jaw by sideways movements takes the prey and slowly pushes it inside the gullet. After completely swallowing the prey, it also "yawns" twice or thrice. During this process of swallowing the peristaltic movements of the abdomen were also visible. Attempts were made earlier to offer live pigeons, bandicoots and guinea-pigs but none were taken.

According to Gowda (1963) who observed it in Mysore Zoo, the King Cobra when hungry approaches its prey, bites it and injects venom only sufficient to reduce it to a state of unconsciousness, and not to kill it; then it begins to swallow the snake entirely from the head region. He further stated that the whole process from the time of attack to the time it completely swallowed its prey took about half an hour, and that it did not feed on dead snakes.

At the Rotterdam Zoo, frozen snakes have been successfully fed to the King Cobra after thawing, though it was necessary to move the body inside the enclosure to induce it to bite it, prior to eating (Polder 1969).

The main diet of the King Cobra in a state of nature is snakes, presumably taken alive, and it is possible that this habit and method of taking dead and disabled snakes has developed in captivity.

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21. LARGE SCALE INCIDENCE OF SEXUAL ABNORMALITY IN THE FROG *RANA TIGERINA*

Isaac (1969)[1] reported a case of sexual abnormality in the skipper frog *Rana cyanophlyctis*, where a female frog had vocal sacs and nuptial pads. During a demonstration of urinogenital system to students, we have come across 15 specimens of *Rana tigerina* with sexual abnormality in a total of 75 specimens. All the 15 specimens were males with well developed testis, vocal sacs and nuptial pads. But, all of them had fully developed oviducts opening into the cloaca. No other anatomical abnormality could be noticed excepting that the testes are slightly longer when compared to normal individuals. Each testis is spindle shaped, yellowish, measuring about 11 mm in length. It is presumed that all these abnormal individuals are functional males, though they have well developed oviducts. There is no trace of ovary, however. One of the specimens, measuring 95 mm from snout tip to vent, has been deposited in the Zoology Museum, D.N.R. College.

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[1] ISAAC, S. (1969): Presence of vocal sacs in a female skipper frog *Rana cyanophlyctis* Schneider. *J. Bombay nat. Hist. Soc.* *66*(3):635.

22. ON THE OCCURRENCE OF THE GOBY, *BRACHYGOBIUS NUNUS* (HAM.-BUCH.) IN ANDHRA PRADESH, WITH A NOTE ON ITS ECOLOGY

(*With a text-figure*)

The banded goby, *Brachygobius nunus* (Hamilton-Buchanan 1822) originally described as *Gobius nunus* from Calcutta, has a long nomenclature history. Subsequent to the original record, it was described as *Gobius doriae* (Gunther 1869), *Gobius alcockii* (Annandale 1906), *Ctenogobius nunus* (Hora 1934), *Brachygobius xanthomelas* (Herre 1937) and as *B. sua* (Smith 1945). Weber & de Beaufort (1953) re-examined the types of *Gobius doriae* in the British Museum, of *Brachygobius xanthomelas* in the Stanford University and of *Gobius alcockii* in the ZSI and synonymised them with *Brachygobius nunus* (Ham.-Buch.). The species was earlier recorded from Madras by Koumans (1941). The present note extends its range of distribution to Andhra Pradesh.

Fig. 1. *Brachygobius nunus*
18 mm total length, Bhimavaram.

Description: Based on 10 specimens, 15-18 mm total length (one, a female 15 mm, bearing 157 eggs in ovary). Branchiostegals 5, D_1 5-6, D_2 8, P 13-16, V 5-6, A 7-8, Vertebrae 10 + 14 = 24. Depth 3.5-4.6, head length 2.8-3.7, head width 2.8-3.7, all in standard length.

Body cylindrical anteriorly, compressed towards tail. Lower jaw projecting beyond upper jaw, fine teeth on margins of both jaws. Maxillary extends to below anterior margin of eye. Pectorals obtusely rounded, origin behind gill opening; ventrals form a disc at their base. Height of first dorsal less than that of second; the latter situated about $\frac{1}{2}$ eye diameter behind tip of depressed first dorsal, height greater than eye diameter. Anal opening at tip of a small papilla. Anal origin below second ray of second dorsal, length equal to eye diameter. Caudal obtusely rounded or truncate. Body covered with ctenoid scales.

Colour: Two kinds of colour pattern have been observed from the same locality: 1. Dorsal side yellowish-green becoming pale towards ventral side with a series of vertical bands; first band dark, between eyes and descending to below eye on either side; second band indistinct, at level of opercules; third band dark, behind pectoral origin, ascending into first two dorsal rays; fourth band below anterior half of second dorsal; fifth band just behind second dorsal; sixth band on caudal peduncle; sometimes one or two incomplete dark bands are found between the fifth and sixth; fins hyaline. 2. The fifth complete dark band is on the caudal peduncle. Between the latter, and the fourth band below second dorsal, are two incomplete bands.

Ecology: This species is perhaps more widespread than is known at present. Because of its small size, it is not captured in the gear operated by local fishermen. It can be collected in portable plankton nets. It occurs in tanks with pH 7.9, temperature 24°C, having plants like *Nymphaea nouchali, N. stellata, Ipomoea reptans, Spirogyra* sp., and rich in Cladocera and Copepoda. It remains attached to the under surface of leaves of lotus when disturbed.

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WEBER, M. & DE BEAUFORT, L. F. (1953): Fishes of the Indo-Australian Archipelago, p. 194.

23. ADDITIONS TO THE FOOD PLANTS OF INDIAN RHOPALOCERA

Mr. Sevastopulo has done a great service to Indian entomology by collating in one comprehensive list most of the scattered references to the food plants of Indian Rhopalocera (*JBNHS, 70*:156-183). There must still, however, be a large number of published references and unpublished records of casual observations. If these could be sent to the Society for publication our recorded knowledge would be much more complete. As a start, here are a few observations and additions, some of which have previously been published in the *Journal*.

PAPILIONIDAE

Polydorus philoxenus Gray. As far as I am aware, *khasiana* is the only Indian species of the genus *Nepenthes*. It is a rare plant, with a restricted and localised distribution, being confined to the Khasi and Jaintia and North Cachar Hills of Assam. The widely occurring *philoxenus* must, therefore, feed on a different food plant throughout most of its range.

PIERIDAE

Delias aglaia L. I confirm that this feeds on *Loranthus* sp. in Sibsagar Dt. of Upper Assam.

SATYRIDAE

Elymnias nesoea Wall. Larvae found on various wild canes and palms.

Elymnias vasudeva M. ♀ hatched 29-vii-56 from pupa found on an eaten spray of *Dendrobium ? fimbriatum* (Orchidaceae). Sibsagar Dt., Upper Assam.

NYMPHALIDAE

Eriboea arja Fd. *Albizzia* sp. in Sibsagar Dt. of Upper Assam.

Euripus halitherses Db. and Hew. Feeds on an Urticaceous shrub in Sibsagar Dt. of Upper Assam.

Pareba vesta F. Urticaceous plants in Sibsagar Dt. of Upper Assam.

LYCAENIDAE

Spalgis epius Wd. Carnivorous on mealy aphids (on *Citrus*), Upper Assam.

Lycaenopsis oreas oreana Swinh. *Prinsepia utilis* (Rosaceae), Khasi Hills. (I recorded this fact in *JBNHS, 49*(3):569, using the old name of *huegelii oreana* for *oreas oreana*).

Zizera otis F. A small leguminous plant with a purple flower, Upper Assam.

Catochrysops strabo riama Corbet. Flowers of *Pongamia glabra* (Leguminosae), Upper Assam.

Catochrysops panormus exiguus Dist. Flowers of *Pongamia glabra,* Upper Assam.

Jamides bochus Cr. Flowers of *Pongamia glabra,* Upper Assam.

Jamides alecto alocina Swinh. Flowers and seedpods of *Hedychium* sp. (Zingiberaceae), Sibsagar Dt., Upper Assam.

Nacaduba nora nora Fd. Flowers of *Pongamia glabra,* Upper Assam.

Amblypodia centaurus F., *Lagerstroemia* sp. (Lythraceae) attended by the ant *Oecophylla smaragdina.*

Chliaria othona Hew. The seedpods of several species of epiphytic Orchidaceae, Upper Assam.

Rapala pheritima petosiris Hew. Flowers and leaves of *Cassia fistula* (Leguminosae) and leaves of *Lagerstroemia* sp. (Lythraceae) attended by the ant *Oecophylla smaragdina,* Upper Assam.

HESPERIIDAE

Hasora chromus chromus Cramer. *Pongamia glabra* (Leguminosae).

Hasora badra M. *Derris scandens,* Upper Assam.

Gangara thyrsis F. The common food plant in Upper Assam is one of the prickly rattans, *Calamus* sp.

T. NORMAN

THE OLD RECTORY,
WINTERBORNE HOUGHTON,
BLANDFORD, DORSET, U.K.,
August 19, 1974.

24. EXTENSION OF RANGE OF THE TERMITE *ODONTOTERMES GUPTAI* ROONWAL & BOSE (ISOPTERA: TERMITIDAE: MACROTERMITINAE)

The species was originally described as a subspecies *Odontotermes bellahunisensis guptai* by Roonwal & Bose (1962). Roonwal & Bose (1962, 1964) reported it from Rajasthan (Districts of Bikaner, Jhunjhunu, Nagaur, Sikar, Udaipur) and Sind (Karachi). Roonwal & Verma (in press) raised it to species rank and recorded it also from Ajmer District, Rajasthan. The present records extend its known range of distribution to Uttar Pradesh.

Odontotermes guptai Roonwal & Bose

Material: A vial with several soldiers and workers; Dehra Dun, Uttar Pradesh; *S. C. Verma,* coll.; 16-ix-1974; *ex.* papaya plant.

Measurements: Body measurements (in mm) of 4 soldiers from Dehra Dun. Body length with mandibles 3.9-4.1; Head length with mandibles 1.66-1.81; without mandibles 1.05-1.16; Head width 1.02-1.05; Mandibles length 0.58-0.66; Postmentum (median) length 0.53-0.58; Max. width 0.42-0.44; Pronotum length 0.47-0.50, width 0.78-0.83; Antennal segments 16.

ACKNOWLEDGEMENTS

We are thankful to Dr. B. S. Lamba, Deputy Director (Officer-in-charge) for facilities and to Dr. Asket Singh, Superintending Zoologist, Zoological Survey of India, Dehra Dun, for useful suggestions.

ZOOLOGICAL SURVEY OF INDIA,
13 SUBHAS ROAD,
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25. STUDIES ON THE APHIDIDAE OF INDIA—XV. ON THE BIOMETRY OF MORPHOLOGICAL CHARACTERS OF *APHIS CRACCIVORA* KOCH. (APHIDIDAE, HOMOPTERA)

INTRODUCTION

Cottier (1953) studied variation in five different species of aphids viz., *Myzus persicae* (Sulz.), *Macrosiphum euphorbiae* (Thomas), *M. rosae* (L.), *Aulacorthum solani* (Kalt.) and *Aphis citricidus* (Kirk.) in New Zealand and emphasised the importance of the relative proportions which antennal segments bear to one another and to cornicles and cauda, in the determination of a species. He gave importance to the ratios of antennal segments IV, V, VI (base) and VI (flag.) to the antennal segment III and of cornicle and cauda to antennal seg. III and to each other in order to distinguish one aphid species from another. Other taxonomists like Theobald (1926-1929), Takahashi (1924), Eastop (1958, 1961), and Bodenheimer and Swirski (1957) have also in addition laid emphasis on the ratios of lengths of different parts of the body such as antenna/body, body/cauda, body/cornicle etc., in the determination of an aphid species. However, all this biometry applies to the adult alate and apter-

TABLE 1

MEAN MEASUREMENTS (IN MM) OF CHARACTERS OF DIFFERENT INSTARS OF *Aphis craccivora* Koch.

Characters (Lengths unless otherwise mentioned)	First instar	Second instar	Apterae Viviparae			Alatae Viviparae			
			Third instar	Fourth instar	Adult	Second instar	Third instar	Fourth instar	Adult
Body	0.738	1.176	1.231	1.469	1.992	1.094	1.183	1.422	1.808
Antenna	0.383	0.565	0.730	0.859	1.361	0.625	0.756	1.038	1.306
Antennal seg. III	0.122	0.136	0.208	0.149	0.332	0.162	0.223	0.197	0.293
Antennal seg. IV	*	0.081	0.113	0.126	0.241	0.089	0.120	0.176	0.252
Antennal seg. VI (base)*	0.050	0.070	0.081	0.089	0.117	0.075	0.080	0.098	0.119
Antennal seg. VI (flag.)	0.122	0.167	0.198	0.234	0.299	0.180	0.210	0.266	0.280
Cornicle	0.053	0.109	0.171	0.213	0.382	0.110	0.140	0.211	0.253
Basal breadth of cornicle	0.063	0.075	0.085	0.093	0.097	0.075	0.081	0.091	0.066
Apical breadth of cornicle	0.046	0.048	0.054	0.059	0.053	0.052	0.054	0.059	0.046

* Antennal segment IV is the ultimate segment of first instar and is homologous to the segment VI of fourth instar and adult. Similar homology exists for the segment V of second and third instars with the segment VI of later stages.

TABLE 2

RATIOS OF MEASUREMENTS OF DIFFERENT MORPHOLOGICAL CHARACTERS IN DIFFERENT INSTARS OF *Aphis craccivora* Koch.

Ratios of characters	Value of ratios	First instar	Apterae Viviparae				Alatae Viviparae			
			Second instar	Third instar	Fourth instar	Adult	Second instar	Third instar	Fourth instar	Adult
Antenna/body	0.60 ±0.12	0.51	0.48	0.59	0.58	0.68	0.57	0.63	0.72	0.72
Ant. seg. IV/III*	0.715±0.175	—	0.59	0.54	0.84	0.72	0.54	0.53	0.89	0.87
Ant. seg. VI (base)/III*	0.47 ±0.08	0.40	0.51	0.38	0.59	0.35	0.46	0.35	0.49	0.40
Ant. seg. VI (flag.)/III	1.235±0.335	1.0	1.22	0.95	1.57	0.90	1.11	0.94	1.35	0.95
Ant. seg. VI (flag.)/VI (base)	2.53 ±0.18	2.44	2.38	2.44	2.62	2.55	2.40	2.62	2.71	2.35
Length of cornicle/basal breadth	—	0.84	1.45	2.01	2.29	3.93	1.46	1.72	2.31	3.83
Length of cornicle/apical breadth	—	1.15	2.27	3.16	3.61	7.20	2.11	2.59	3.57	5.50
Basal breadth of cornicle/apical breadth	—	1.36	1.56	1.57	1.57	1.83	1.44	1.50	1.54	1.44
Length of cornicle/ant. seg. III	—	0.43	0.80	0.82	1.42	1.15	0.67	0.62	1.07	0.86
Body/cornicle	—	13.92	10.78	7.19	6.89	5.21	9.94	8.45	6.73	7.14

* See foot note under Table 1.

ous parthenogenetic forms. The question arises, can nymphal forms be determined by the application of biometry of adult forms? The present investigation deals with a study of ratios of morphological characters of nymphs and adult stages of the common bean aphid, *Aphis craccivora* Koch., in order to find an answer.

Material and Method

Apterous adult parthenogenetic forms of *A. craccivora* were collected in the field on *Dolichos lablab* in the University campus, Bhubaneswar during December 1973 and were maintained in the Laboratory. The young laid were kept separately in petri dishes on the leaves of the host plant and reared upto the adult condition. Such nymphs always developed into apterous adults. The mean temperature and humidity in the laboratory was 20.2°C and 66 per cent respectively. It is well known that alate forms are formed under various conditions, principal among which are overcrowding, food shortage and the physiological urge for migration. The first instar nymphs destined to develop into alate and apterous adults are alike. But in the second instar the respective nymphs can be distinguished (Behura, *et al.*). Such nymphs were collected in the field and reared in the laboratory in order to study the ratios of measurements of morphological characters of nymphs developing into alate.

Individuals of different instar nymphs were preserved separately in 70 per cent alcohol. Permanent slides were prepared as per technique described by Behura and Dash (1973). Measurements of different parts of the body of ten nymphs of each nymphal stage for alate and apterous forms were recorded and their ratios studied. The data are presented in Table 1. Ratios of important taxonomical characters were calculated and are set in Table 2.

Results and Conclusions

1. Taxonomic ratios (Table 2) viz., antenna/body, ant. seg. IV/III, VI (base)/III, VI (flag.)/III and VI (flag.)/VI (base) are constant in all nymphal instars and adults of apterous and alate forms of *A. craccivora*. However, the ratio of length of antennal seg. VI (flag.)/III is slightly greater in the fourth instar stage of both apterous and alate forms due to the division of seg. III after the third moult.

2. The ratios concerning the dimensions of the cornicle present some interesting results.

(a) The ratios of length of cornicle/basal breadth and length of the cornicle/apical breadth increase from first instar to the adult.

(b) The ratio, basal breadth of cornicle/apical breadth of cornicle in the apterous forms increases from first to third instar, remains constant in the fourth instar and then increases in the adult. This ratio in the alate forms however, increases from first to fourth instar and then decreases in the adult.

(c) The ratio, length of cornicle/ant. seg. III in both alate and apterous forms increases from first to fourth instar and then decreases in the adult.

(d) The ratio, length of the body/cornicle in apterous forms decreases from the first instar to adult, but in alate forms the decrease is only upto the fourth instar stage and then there is an increase in the adult.

Thus it appears, the ratios relating to the antennal segments are almost constant in nymphs and adults of apterae and alate but the ratios relating to the cornicle vary.

Summary

The important taxonomic ratios in the nymphs and adults of alate and apterous forms

of *Aphis craccivora* Koch., have been studied. The ratios antenna/body, ant. seg. IV/III, VI (base)/III, VI (flag.)/III and VI (flag.)/VI (base) remain almost constant in all the stages. But the ratios relating to the cornicle, such as length of cornicle/basal breadth, apical breadth and ant. seg. III, basal breadth/apical breadth and body/cornicle show variation.

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26. *DACTYNOTUS COMPOSITAE* (THEOBALD), A NEW APHID PEST OF MULBERRY (*MORUS* SPP.)

Periodical survey and study conducted on the pests of mulberry (*Morus* spp.) at Dharwar, Karnataka, during the year, 1974-75 revealed heavy infestation by *Dactynotus compositae* on mulberry, although safflower is the primary host plant of this insect. The aphids were found feeding in groups on tender shoots and also on the ventral surface of tender leaves. When nymphs of this aphid were enclosed on the twigs of mulberry, the aphids fed and developed successfully into adults. Another interesting feature observed during the period of investigation was most of the aphids on mulberry were alate forms. *D. compositae* has not been recorded as a pest of mulberry, so far.

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27. POST EMERGENCE BEHAVIOUR OF *CHRYSOMYIA MEGACEPHALA* (FABR.) (DIPTERA: CALLIPHORIDAE)

INTRODUCTION

Detailed information is awaited about the role of the ptilinum, mechanism of emergence from the puparium, subsequent inflation of the body and expansion of wings in a number of dipteran insects (Fraenkel 1935; Laing 1935; Hinton 1946 and Cottrell 1962, 1964). But not much is documented regarding the behaviour of the animal prior to attaining the power of flight. The present observations are made to record the behavioural pattern of *Chrysomyia megacephala* right from their emergence from the puparia to the expansion of the wings.

METHOD

Pupae (4-5 days after pupation) collected from laboratory reared flies were kept in a cotton plugged conical flask and thereafter the stepwise sequence of the emerging flies was observed.

RESULTS: Deep ash coloured "curious looking" small flies having truncated abdomen emerge through a fracture (Hinton 1946) or line of weakness at the narrow end of the puparium. Onset of emergence could however be seen by the rhythmic activity of the ptilinum (Knab 1911). After their exit and before discarding the puparia they lie on their back and rapidly roll the puparia with all their six legs for a few seconds. Later they become briskly active but cannot maintain normal posture. This is evident from their frequent falls from the wall of the flask. After a lapse of two to three minutes, the flies attain their posture coordination and move towards the top of the flask in order to escape. Eventually the ptilinum which remains inoperative just after emergence regains vigorous to and fro movement causing spectacular lateral shifting of the eyes. In doing so, the gripping of three pairs of legs is noteworthy. This condition continues for fifteen to twenty minutes. Later on, the fly engages its first pair of legs exclusively to dress the frontoclypea suture and adjoining parts of the head capsule. Respite prevails for a few minutes and then abrupt "expansion" of the entire body ensues and as a result, the colour fades, abdomen curves and its truncated condition subsides. In the next phase, flicking out of the proboscis and decurling of the wings occur. Smoothening of the wings with the help of posterior pair of legs exclusively one after another to iron out the creases is specially remarkable. After the completion of such morphological changes, the fly takes rest when gradually an iridescent pigmentation (metalic green) develops first at the thorax and then the abdomen. The entire sequence of changes for assuming the full fledged condition of the fly requires about thirty minutes.

DISCUSSION

From the above findings it is suggested that the characteristic inflation and deflation of the ptilinum near the cotton plug may be due to a preadaptational habit of the imago which is evident during the process of eclosion and digging in natural condition (Fraenkel 1935). Dressing of the head capsule by employing fore pair of legs is possibly for reorganising the frontoclypeal and mediovertical sutures (Hinton 1946) and signals the complete cessation of ptilinal activity due to hardening of the cuticle (Cottrell 1964). Rest for a while prior to expansion of the body is difficult to inter-

pret at the moment but may be considered as a preparatory phase for mitigating the ensuing morphodynamic changes. Further work is in progress to substantiate this contention. The sudden expansion of the body particularly of the abdomen, unfolding of the wings and appearance of the specific pigments have some relevance when air swallowing (Knab 1911), preparation for attaining perfect flight and chromatophorotropic effect in conjunction with darkening factor (Burnet 1963).

Summary

This communication describes the behavioural pattern of *Chrysomyia megacephala* just after their emergence right upto gaining the power of flight in laboratory condition. Emergence of "curious looking" fly from the puparium with the help of ptilinum, method of discarding the puparium, invoking the activity of the ptilinum temporarily and expansion of the entire body are remarkable. Division of labour for dressing the head capsule and decurling of the wings by fore and hind pairs of legs respectively and gradual appearance of metallic green colour are some of the interesting phenomena during this period. The entire event requires an interval of thirty minutes. The probable import of such behavioural pattern and morphological alterations in the emerging adult has been interpreted from the standpoint of ecomorphology and physiology.

Acknowledgements

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28. *CULCITA PENTANGULARIS* GRAY (ASTEROIDEA: OREASTERIDAE)—A NEW RECORD FROM INDIAN WATERS

(*With a photograph*)

During the course of survey in September-November, 1972 of some of the Islands of Andamans, three interesting specimens of a starfish were obtained from the eastern side of Rangat Bay Jetty, Middle Andamans, amidst coral stones partially exposed at lowtide on 24th October, 1972.

A detailed study of the material revealed that it could be assigned to the genus *Culcita* Agassiz of the family Oreasteridae of the order Phanerozonia belonging to the class Asteroidea. In the genus *Culcita* only two species have so far been recorded from Indian waters (i.e. Andaman Sea). These are: *Culcita schmideliana* Retz. and *C. novaeguineae* Müller & Troschell (Koehler 1910); *C. novaeguineae* var. *arenosa* Döderlein and *C. novaeguineae* var. *plana* Döderlein (James 1969). The present material is referable to a third species i.e. *Culcita pentangularis* Gray which had hitherto not been recorded from Indian waters. Previously it was known from the reef of Oomaga, North Western Australia (Type locality, Gray 1866); Off Mozambique, Torres Strait and Fiji Islands (Sladen 1889) and Zanzibar (Bell 1903). The present record is of interest and bridges the gap between Eastern Archipelago and East Coast of Africa. Detailed description and figures are provided in this paper.

Culcita pentangularis Gray

Body pentangular; arms short, not distinguished clearly from the disc. The measurements of three specimens from the disc centre to the tip of the ambulacral groove are 122 104 and 89 mm, the diameter of the disc 85, 78 and 71 mm and height at centre of disc 95, 90 and 75 mm.

Ground colour of both surfaces in live specimens, light purple but the papular areas and the tubercles on the aboral surface and the tubercles and ambulacral spines surrounding the distal halves of the ambulacral grooves are deep purple.

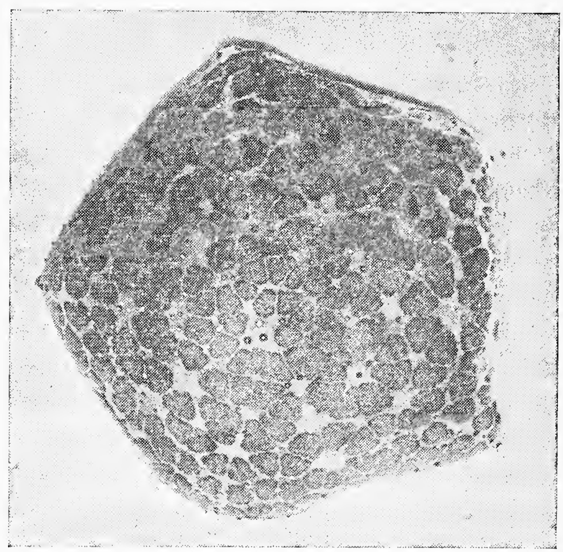

Photo. Aboral view of *Culcita pentangularis* Gray.

The external surfaces of the aboral side is rough due to presence of irregularly arranged conical tubercles (2 mm in height and diameter) borne by underlying platelike endoskeletal ossicula which are covered by leathery skin. The reticulation, characteristic of this family, is not visible in this species. Besides the tubercles, aboral surface possesses papular areas,

large, irregular in shape but well defined, giving a mosaic appearance to this surface. Minute pores are present outside these areas in the interspaces of the tubercles (Photo.).

Oral surface is also guarded by well defined ossicula and possesses numerous roundish tubercles. Some (smaller ones) arranged in groups ranging from 8-14 in a group, some (larger and higher) are found near the ambulacral edge and disc periphery whereas those near the oral operture are the largest and highest. The interspaces of the tubercles are occupied by closely set small granules.

The edges of the ambulacral grooves are lined with a series of large spines; each spine is flat with serrated top and made up of 4-6 rod like structures joined together. The shape of the tubercles along the ambulacral edge is usually bilobed in the proximal two-thirds and conical but gradually reduced in size in the distal one-third. The groove ends are always attended by a terminal pointed tubercle. The ambulacral grooves extend on the aboral surface also.

The tube feet are large, upper rows of marginal ossicula are absent. Single madreporite—an oval shaped plate situated inter-radially about 25 mm from the centre.

In living condition, five rayed aperture (mouth) was clearly prominent and surrounded by well developed oral spines, Anus is lacking.

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29. *SOLIVA ANTHEMIFOLIA* (JUSS.) R. BR. A NEW RECORD FROM DELHI AND WESTERN UTTAR PRADESH

Soliva anthemifolia (Juss.) R. Br. a native of South America recorded from Ramnagar, north U.P. and Bahraich, eastern U.P. in 1963 by Bhattacharya. This is followed by other reports from Dehra Dun (Babu 1966; Singh 1969) and from Rajasthan (Maheshwari & Singh 1972). We collected this species during winter months of 1971-73 from several places in Meerut, Bulandshahr, Saharanpur and Delhi. The plants are more suited to moist exposed habitats and the species is rapidly spreading in several areas including cultivated fields.

This taxon is characterized by its prostrate habit, rooting, leaves, position of heads, female ray-floret without corolla; flattened winged achenes with persistent barbed bifid-style.

The specimens collected are deposited in the herbarium of Botany Department, Meerut University, Meerut.

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30. *INDIGOFERA KARUPPIANA* NOM. NOV.

A small herbacious papilionaceous plant was collected from Sirumalai hills, Madurai Dt., of Tamil Nadu (Madras State) which on identification was found to be *Indigofera vestita* Baker in FL. BRIT. IND. *2*:96, 1876.

This is a later homonym of Harvey in Harvey and Sonder, FLORA CAPENSIS *2*:182, 1859-65. Hence it is an illegitimate name and has to be rejected according to Article 64 of the International Code of Botanical Nomenclature, 1972. There is no earlier valid name for our plant which is indigenous to Tamil Nadu. Consequently, according to Article 72 of the same code, a new name has to be given to it.

The specific epithet *karuppiana* is chosen in gratitude to Mrs. Karuppia Nadar and Sons who generously financed our two years' exploration of Sirumalai hills.

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31. *ACANTHOSPERMUM AUSTRALE* (LOEFL.) KTZE. A NEW DISTRIBUTIONAL RECORD FOR THE PLAINS OF PUNJAB

Recently in August 1972 we collected specimens of *Acanthospermum australe* (Loefl.) Ktzs. (= *A. hispidum* DC.) (Compositae) from Chandigarh growing along road sides in Madhya Marg, Sector 17. This species has not been reported from Punjab by earlier workers (Parkar 1924; Sharma & Sharma 1966), and thus seems to be a recent introduction.

It is a native of South America and was reported from South India by Mayurnathan (Mayurnathan 1939). Since then it has spread fast and was subsequently reported from several parts of Madhya Pradesh, Rajasthan and the Plains of Uttar Pradesh (Raizada & Sharma 1962). Recently it has also been reported from Almora (Singh 1973).

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SINGH, V. (1973): A New Distributional Record for *Acanthospermum australe* (Loefl.) Ktze. *Curr. Sci. 42*(2):68.

32. *PTERIS TREMULA* R. BR.—A NEW RECORD FOR INDIA

While examining the herbarium specimens of the genus *Pteris* housed in the Cryptogamic Unit of the Botanical Survey of India, Calcutta, we came across a specimen which did not fit in with any of the species of the genus so far described from India. On closer scrutiny and comparison with specimens from New Zealand and Australia kept in the Central National Herbarium, Sibpur, it was confirmed that this specimen is *Pteris tremula* R. Br. which is a native of Australia, Tasmania and New Zealand. As this is a new record for India, it is described.

Pteris tremula R. Br. Prodr. Fl. N. Holl. 154, 1810; Agardh, Recens. Pterid. 40, 1839; Hook. Sp. Fil. 2:174, t. 120B, 1858; Hook. et Baker, Syn. Fil. 161, 1874; Christ, Farnkr. 169, 1897; Diels, in Engl. et Prantl, naturl. Pflanzenfam. 293, 1899; C. Christens. Ind. Fil. 608, 1906; Rosenb. Mal. Ferns All. Suppl. 1:251, 1916. *P. affinis* Rich. in Bot. Astrol. 81, 1832; A. Cunn. in Hook. Comp. Bot. Mag. 2:365, 1836. *P. kingiana* Endl. Prodr. Fl. Norf. 13, 1833. *P. chrysocarpa* Link. Hort. Berol. 2:33, 1833. *P. tenuis* A. Cunn. in Hook. Comp. Bot. Mag. 2:365, 1836.

Stipes 30-35 cm long, hard, erect, glabrous, glossy, chestnut brown. Fronds (excluding stipe) 30-40 cm long, 15-25 cm broad, 2-3 pinnate, upper pinna subsessile, lower pinna petiolate, length of petiole 0.3 cm to 1 cm; pinnae 0.5 cm to 3.5 cm × 3.5 cm to 11 cm; terminal pinna has linear closely placed lobes with decurrent base; costa mostly grooved on the lower surface; pinnule 2 mm to 2.5 mm × 6 mm to 4 cm, subcoreaceous, apex acute or rounded, margin dentato-crenate, sinus less than 1 mm, base decurrent; rachis glabrous; veins once or rarely twice forked, prominent on the lower surface; sorus continuous along the margin of the pinnule except the apex.

Specimen examined.—Hansden, Shevroy Hills (Tamil Nadu), *J. Ghatak* E112 (June 18, 1961), under shade by a stream.

BOTANICAL SURVEY OF INDIA,
76 ACHARYA JAGDISH BOSE ROAD,
CALCUTTA 14,
March 18, 1974.

N. C. NAIR[1]
S. R. GHOSH

[1] *Present address*: Regional Botanist, Central National Herbarium, Botanical Survey of India, Sibpur, Howrah 3 (W.B.).

33. SOME NEW RECORDS OF PLANTS FROM LUCKNOW DISTRICT (U.P.)

While undertaking intensive plant collections in the district, I came across 14 species of Angiosperms and 13 species of Pteridophytes, which have not been previously recorded in any of the published accounts of the flora of the district. The specimens are deposited in the Herbarium of Botany department, B.S.N.V. Degree College, Lucknow. The Angiospermic taxa along with their localities are given below.

MALVACEAE

Abutilon asiaticum G. Don (= *Sida asiatica* Linn.)

Common near Moosa Bagh forest and along Lucknow-Barabanki road near Chinhat.

Sida ovata Forsk. (= *S. grewioides* Guill. & Perr.)

On the boundary of the fields along Lucknow-Kursi road.

SAPINDACEAE

Cupania fuscidula Kurz

Along the sides of Lucknow-Sitapur road.

C. pleuropteris Blume

Along the sides of Lucknow-Sitapur road.

FABACEAE (PAPILIONACEAE)

Crotalaria bialata Schrank (= *C. alata* Buch.-Ham. ex D. Don)

Very common in the fields of Rahimabad and uncommon in Kukrail forest.

C. notonii W. & A. (= *C. trifoliastrum* Wall., *C. rostrata* W. & A.)

Kukrail forest and Mohanlalganj.

CAESALPINIACEAE

Cassia italica (Mill.) Lamk. ex Ander. (= *C. obtusa* Roxb.)

Near La Martiniere College and on the sides of Lucknow-Sitapur road.

ACANTHACEAE

Aechmanthera gossypina (Nees) Nees (= *A. tomentosa* Nees)
In moist places at Banthara.
Asystasia coromandeliana Nees
Banthara.

VERBENACEAE

Lantana indica Roxb. (= *L. dubia* Wall., *L. collina* Decne., *L. alba* Schauer)
This taxon is often confused with *Lippia javanica* Bl. but can well be distinguished by its opposite leaves, long peduncles and larger drupes.
Military farm and on the sides of Hardoi and Mohaun roads.

AMARANTHACEAE

Amaranthus tenuifolius Willd. (= *A. angustifolius* Roxb.)
On the banks of Gomati river near Military farm and Bakshi-ka-Talab.

POLYGONACEAE

Polygonum stagninum Buch.-Ham. ex Meissn.
On the banks of Gomati river.

EUPHORBIACEAE

Euphorbia laeta Heyne ex Roth (= *E. rothiana* Spreng.)
In mango orchards of Malihabad, Dilkusha and on the sides of Lucknow-Mohaun road.

CYPERACEAE

Eleocharis palustris R. Br. (= *Heleocharis palustris* R. Br.)
In paddy fields of Malihabad and Chinhat.

ACKNOWLEDGEMENT

I am grateful to Dr. B. S. Trivedi, Reader in Botany, Lucknow University, Lucknow for his help and suggestions.

LECTURER IN BOTANY,
B. S. N. V. DEGREE COLLEGE,
LUCKNOW, U.P.,
January 17, 1974.

R. B. TEWARI

34. *INDIGOFERA BENTHAMIANA* HANCE. (PAPILIONACEAE)—A NEW RECORD FROM INDIA
(*With a plate*)

During the course of a botanical study tour, I collected specimens of a species of *Indigofera* Linn. in the months of August-September 1972 from three different parts of Quilon District namely Chandanathoppu near Quilon, Chengamanadu near Punalur, and Parakode near Adoor. The species was subsequently identified as *Indigofera benthamiana* Hance. and it is preserved in the Sree Narayana College Herbarium at Quilon. According to Kew authorities the species, was originally described from S. China near Canton, and has not so far been reported from India. Description and drawings of the species given here are based on fresh specimens.

Indigofera benthamiana Hance. A small tree with angled branches, adpressed black hairy throughout especially when young. Leaves alt-

Indigofera benthamiana Hance.
a. Portion of a twig, b. Flower, c. Bract, d. Calyx, e. Standard, f. Wing, g. Keel, h. Anther, i. Androecium, j. Gynoecium, k. Fruit, l. Seed.

ernate, upto 30 cm or even more long, odd-pinnate and stipulate with 15-23 leaflets; stipules linear subulate; petiolule small, 3-5 mm long; stipels minute; blade ovate-lanceolate to linear-lanceolate with an acute mucronate tip, the terminal ovate-elliptic, to 9.5 cm long, 3.5 cm broad, adpressed hairy above and below. Inflorescences axillary racemes, standing erect from horizontal branches, closely adpressed black hairy; peduncle upto 20 cm or longer carrying over hundred flowers, each subtended by a linear subulate caducous bract about 3 mm long. Flowers 10-12 mm long, shortly pedicellate; calyx small, zygomorphic, 2.5-3 mm long, shortly subequally 5-lobed, adpressed hairy outside; standard almost sessile, ovate, obtusely tipped, reddish-brown, adpressed hairy outside, 9-12 mm long, 6-9 mm broad; wing shortly stalked, deep pink, 7-9 mm long, obtusely tipped, hairy on the margin and the exterior towards the base, closely adherent to the keel near the base; keel shortly clawed, 9-11 mm long, hairy on the upper margin and the exterior towards the obtuse tip, spurred near the base; stamens 10, diadelphous, 8-10 mm long, anthers uniform, apiculate; pistil 8-9 mm long, ovary linear, very finely adpressed hairy, style glabrous with a small terminal stigma. Fruits cylindrical, prominently beaked 3-4.5 cm long including the beak, slightly curved in the middle, thinly adpressed hairy, 10-15 seeded; seeds flat subreniform.

To quote the Kew authorities, *Indigofera benthamiana* Hance. "... is occasionally grown in other countries as an ornamental." But in all the places from where I collected the species, it was being grown as a hedge and green manure plant as *Gliricidia maculata* H.B. ex K. It is said to be even better than the latter as a green manure plant. It is grown either from seedlings or from stem cuttings.

I wish to thank the Director, Royal Botanic Gardens, Kew, for identification of the species. I am also thankful to Prof. P. K. Ramakrishnan of S. N. College for Women, Quilon, who provided the Indian Ink drawings of the plant.

N. RAVI

DEPARTMENT OF BOTANY,
SREE NARAYANA COLLEGE,
QUILON, KERALA,
April 12, 1973.

35. TWO NEW PLANT RECORDS FOR NAGPUR (MAHARASHTRA)

Recently, while making a collection of plants from Nagpur and its neighbourhood, I came across two plants which have not been recorded for this area by earlier workers.

Lobelia chinensis Lour. Fl. Coch. (1790) 514, ed. Willd. (1793) 628: Syn. *L. radicans* Thunb. Trans. Linn. Soc. 2(1794) 330; Roxb. Fl. Ind. 2(1824) 110; Fl. Brit. Ind. 3(1881) 425.

This species was so far known from Java, Poona and Ranchi, and from West Bengal. Balapure 53013 (LWG) moist area near Telankheri Gardens, Nagpur, 10-viii-70.

Parthenium hysterophorus Linn. Sp. Pl. 988, 1753.

This species, a native of southern United States, naturalized in India near Poona in 1956 and since then it has been reported from Kashmir (Jammu), Delhi and Manali (Kulu valley) in Himachal Pradesh. Balapure 53014 (LWG), common in waste places near Ambazari tank, Nagpur, 10-viii-70.

ACKNOWLEDGEMENTS

I am grateful to Dr R. V. Sitholey, Acting Director, National Botanic Gardens, Lucknow for facilities of work and Prof. P. V. Bole, St. Xavier's College, Bombay for comments.

NATIONAL BOTANIC GARDENS,
LUCKNOW,
November 18, 1972.

K. M. BALAPURE

36. *THELYPTERIS AUGESCENS* (LINK) MUNZ & JOHNSTON: A NEW RECORD FROM INDIA

(*With ten text-figures*)

During the course of our study on the thelypteroid ferns, the senior author came across the plants which conformed to the description of *T. augescens* (Link) Munz & Johnston. The specimens were sent to Prof. R. E. Holttum, Kew, England and to Dr. Alan R. Smith, University of California who confirmed the identity of the species, a native of Southern Florida, Cuba and the Islands of Andros and New Providence in the Bahamas. This species was originally described as *Aspidium augescens* by Link in 1841 from a cultivated plant raised from the spores in the Botanic Garden at Berlin. Recently, Smith (1971)[1] has described it along with the other thelypteroid ferns of Southern United States. In India, the plants of *T. augescens* were collected from Valparai, Coimbatore and are a new record. They have been introduced in the fernery of National Botanic Gardens, Lucknow.

Thelypteris augescens (Link) Munz & Johnston is a mesophytic terrestrial fern, growing usually in exposed beds, forming extensive dense clusters. The rhizome is long creeping, *c.* 1 cm across, usually branched and covered with persistent leaf bases and paleae. Mixed with the paleae, unicellular, acicular hairs occur on the surface of the rhizome. Paleae are basally attached, non-clathrate ovate-lanceolate with a broad base and gradually tapered apex (Fig. 1). The apex of palea is terminated by a large globular, glandular cell with dense contents. Paleae are profusely hairy. Unicellular, acicular hairs are borne all over the margin and surface of palea. Mixed with the acicular hairs a few unicellular, glandular hairs (with extracellular cap-like secretion at the apex) also occur on the margin of the paleae (Fig. 7). In some paleae, large, multicellular, glandular hair with a globular terminal cell and 1-5 celled stalk occur in addition on the margin of the palea; sometimes, unicellular, acicular hair is borne on the stalk of the hair (Fig. 6). In the young palea a few large subglobose hairs with dense yellowish-brown contents occur on the margin of the paleae; the hairs are devoid of any secretion and are sometimes stalked. These hairs are usually borne towards the basal-half region of the palea and are shed off towards maturity.

The ground tissue of the rhizome consists of thin-walled parenchymatous cells; the cells

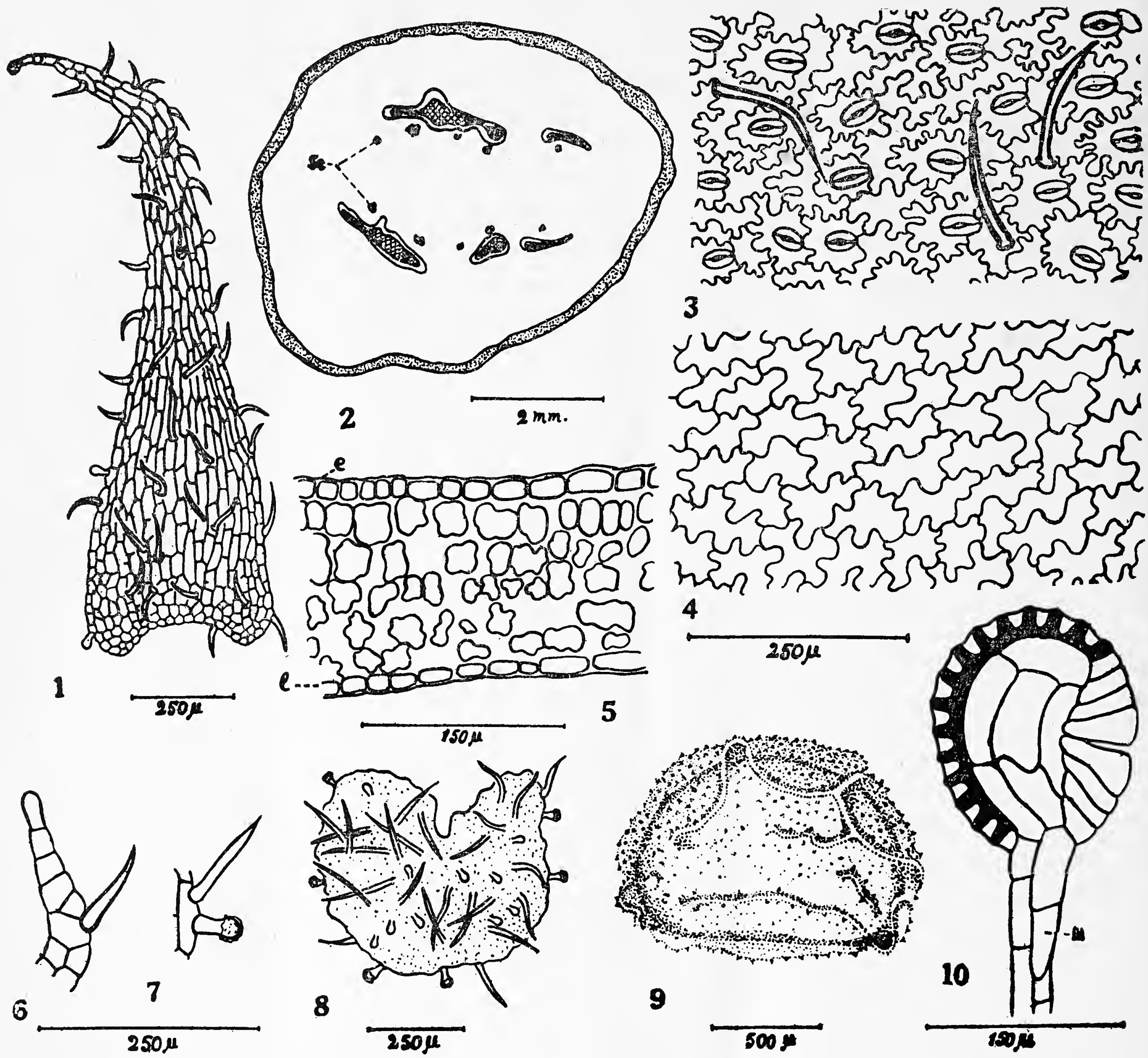
[1] SMITH, A. R. (1971): The *Thelypteris normalis* complex in Southern United States. *Amer. Fern. J. 71*:21-32.

are densely filled with starch deposits. A few irregularly cylindrical strands of sclerenchyma (4-10 cells thick) occur in the ground tissue restricted to the sides of stelar cylinder on either surface (Fig. 2). These strands consist of highly thick-walled dark brown cells with occluded lumen (Fig. 2--sc). The epidermis of the rhizome is thick-walled. Below the epidermis there is a distinct hydodermal sheath (8-10 layers thick) of thin-walled parenchyma cells; the cells of hypodermis are devoid of contents. The vascular cylinder of the rhizome is dictyostelic, dissected into broad 2-3 ribbon shaped meristele by spirally arranged leaf gaps. Phloem tissue is narrow and surrounds the xylem on all the sides. Pericycle is usually two layered. Endodermis is not very prominent as in the case of other thelypteroid ferns. The cells of endodermis are elongated and radially compressed with slightly thickened radial wall.

Leaves are pinnate and spirally arranged around the rhizome. The stipe is smooth, glabrous and prominently grooved on the adaxial surface. The ground tissue of the stipe is parenchymatous except for a peripheral sclerenchymatous sheath. The peripheral sheath consists of 6-8 layers of thick-walled cells interrupted laterally on either side by prominent aerating bands of loosely arranged parenchyma cells. Irregular strands of sclerenchyma as found in the rhizome occur in the ground tissue of the stipe adjacent to the either surface of vascular bundles. These strands extend up to the apex of the stipe and end blindly. The vascular supply of the stipe consists of a pair of broad, ribbon-shaped, laterally placed vascular strands. Rachis is similar to the stipe in structure and is prominently grooved on the adaxial surface. Unlike stipe, the rachis is hairy; unicellular acicular hairs occur sparsely all over the surface of the rachis.

The frond is ovate-lanceolate in outline with *c.* 26 pairs of lateral pinnae and a distinct terminal pinna. The lateral pinnae are narrow, much elongated (*c.* 9 inch long and *c.* 2 cm broad) and are dissected more than half way to midrib into oblong falcate segments. The basal segment of the lower pinna is distinctly larger than the more distal pinnules. The venation is free and pinnate with primary lateral veins corresponding to the marginal lobes. The main lateral veins are pinnately branched bearing a large number of closely placed unbranched secondary veins which extend obliquely to the margin of the pinna; the veins usually possess clavate apices. The leaf lamina is thick and leathery. Both the upper and lower epidermis are chlorophyllous (Fig. 5--e, 1). The upper epidermis consists of large cells with irregular contour (Fig. 4). The cells of lower epidermis are similar in shape to those of upper epidermis but have the outline more conspicuously sinuous with smoothly rounded identation (Fig. 3). The mesophyll cells are distinguishable into upper elongated, compactly arranged, pallisade-like cells and the lower with short hump-like arms (Fig. 5). The midrib of the pinna is grooved on the upper surface and is profusely hairy. Unicelluar, elongated, acicular hairs are borne all over the midrib on both the surfaces; sometimes the acicular hairs are septate. The lateral veins and nonvenous areas on the upper surface are however, devoid of trichomes. Acicular hairs are profusely borne all over the lower surface of the lamina; the hairs in the nonvenuous areas being slender and much reduced.

The fertile leaves are similar to the sterile ones. Sori are circular, superficial and medianly borne over the secondary lateral veins. The indusium is one cell thick with smooth margin and is composed of narrow elongated radially arranged cells (Fig. 8). Large acicular hairs, similar to the foliar hairs, occur profu-



Thelypteris augescens (Link) Munz & Johnston

Fig. 1. Mature palea. Fig. 2. T. S. of rhizome. Fig. 3. Lower foliar epidermis. Fig. 4. Upper foliar epidermis. Fig. 5. T. S. of a portion of the lamina. Fig. 6. Multicellular glandular hair on the posterior margin of the palea. Fig. 7. Hairs on the margin of the palea. Fig. 8. Indusium. Fig. 9. Lateral view of the spore. Fig. 10. Sporangium.

(e, upper epidermis; l, lower epidermis; sc, sclerenchyma strands; iii, third row of stalk cells).

sely all over the outer surface and margin of the indusium. In addition, unicellular, papillate glandular hairs (with extracellular cap-like secretion at the apex) are also borne on the margin and surface of the indusium. Sporangium is of the common leptosporangiate type with a lense shaped capsule and a slender elongated stalk (Fig. 10). The sporangial stalk is slender, usually four cells long and two cells thick except at the capsule base where there is a short third row of stalk cells. The third row of stalk cell is usually 2 cells long and is in continuation to the stomium cells. The annulus consists of usually 13-15 indurated cells. The stomium is well developed and possesses prominent lip-cells. The sporangium is devoid of trichomes.

Spores are monolete, bilateral, plano-to slightly concavo-convex in lateral view and oblong in polar view (Fig. 9). Perine deep brown in colour, densely and minutely spinulose, partially adhering to exine. Perine folds are irregular, elongated and sometimes forming reticulations. The folds are up to 8 μ high from the exine surface and papillate in optical section, with crenate crest. A pair of characteristic folds are usually present on either side of the laesura. Laesura tenuimarginate, *c.* 18 μ long. Exine smooth, light brown and *c.* 3 μ thick. Sexine is much thicker than nexine. On an average the spores measure 38 × 50 μ (P × E, exclusive of perine).

ACKNOWLEDGEMENTS

We are indebted to Prof. R. E. Holttum and Dr Alen R. Smith for confirming the identity of the specimen and to Dr R. V. Sitholey, Director, National Botanic Gardens, for his keen interest in this work.

NATIONAL BOTANIC GARDENS,
LUCKNOW 1,
March 2, 1972.

PRAKASH CHANDRA
SANTHA DEVI

ERRATUM

Vol. 71(1)—Miscellaneous Note No. 1, on p. 137

Para 3, line 1
for "J. D. Bitkinson" *read* "J. D. Aitkinson"

ADDENDUM

Vol. 72(1)—A new species of *Rotala* from Palghat, Kerala

On page 57

Rotala malampuzhensis sp. nov.

Holotype deposited in Kew Herbarium (H. 868/68). Paratypes deposited in the Herbarium, Department of Botany, University of Calicut.

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AUGUST 1976 Rs. 35

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EDITORS,
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Ecology of the weaver birds[1]

D. N. Mathew
Dept. of Zoology, Calicut University, Calicut, Kerala

(*With a map and a text-figure*)

The publication of SILENT SPRING (Carson 1962) did much to draw attention to the importance of birds to agriculture. In India Mason and Maxwell-Lefroy had investigated the economic status of birds in relation to agriculture by an analytical study of their food as early as 1912. Since then D'Abreu (1920), Mukherjee (1969, 1971) and a number of workers referred to by Mukherjee (op. cit.) have contributed to this subject. Ali & Ripley (1968-1973) presented all the data available on the food of individual species upto the time of publication of their serial volumes. Most of these publications were lists of the stomach contents of birds dissected by these authors.

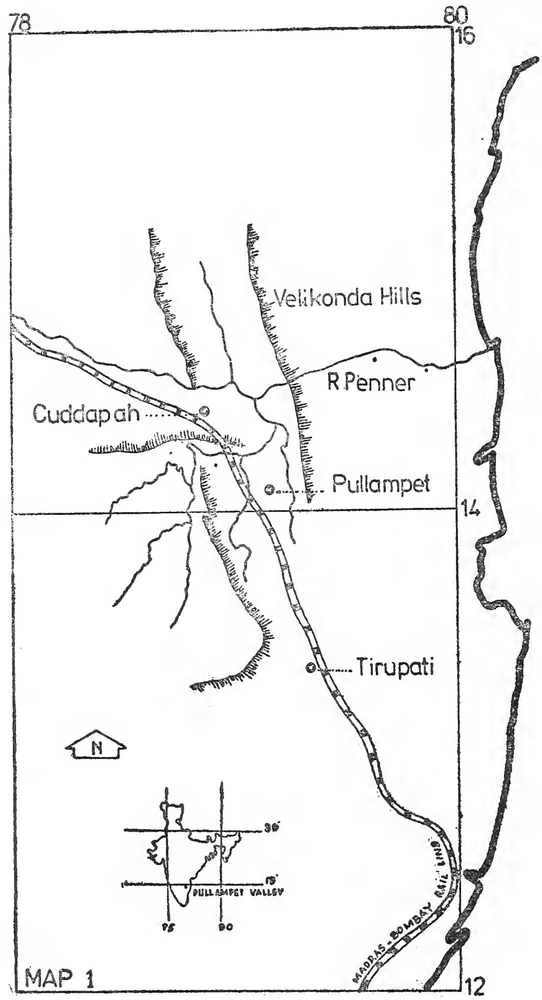
In a general review of Economic Ornithology in India, Sálim Ali (1936) pointed out the need for thorough studies of more aspects of the biology of Indian birds including food, feeding behaviour, life history and population dynamics and emphasized the need for linking research in Economic Ornithology with agricultural research. I had the opportunity to study the ecology and biology of the Baya Weaver bird *Ploceus philippinus* Linnaeus from 1968 to 1971 under the guidance of Dr. Sálim Ali at the Bombay Natural History Society and with the cooperation of the agricultural universities of Andhra Pradesh and Tamil Nadu and the Zoology Department, Madras Christian College, Tambaram. This article[2] gives an outline of my work and a summary of the findings. This work had the financial support of the CSIR.

[1] Accepted August 1975.

[2] Based on the thesis accepted by the Bombay University for the Ph.D. degree 1972.

The Area

The study area was the Pullampet Valley (*c.* 13°44′-14°15′N; 78°59′-79°29′E) in Rajampet Taluk, Cuddapah District of Andhra Pradesh. Pullampet as used here refers to my study area (Map 1) and not to the town of Pullampet which also lies in the same valley. The area is bounded on its three sides by hills



Map. Map showing study area of Pullampet Valley, Rajampet Taluk, Cuddapah district of Andhra Pradesh.

of the Velikonda and the Palkonda ranges.

Pullampet is irrigated by two rainfed tanks through a number of canals, large wells, and a small seasonal hill stream. But for a greater part of the year the country looks burnt up and arid. Clustered around the irrigation wells are a few orchards of mango and patches under betel vine and sugar cane. The bare hills are dotted with a few patches of the aromatic grass *Cymbopogon coloratus* and thorny shrubs like *Zizyphus* sp., growing in sheltered nooks. It is hottest in Pullampet in May and coolest in January; driest in April and most humid in November. The rainy season is between June and December but rainfall is highly variable.

The uncultivated tracts in the study area are sparse scrub-jungles with plants like *Calotropis gigantea* R. Br., *Cassia auriculata* L., *Euphorbia tirucalli* L. and *Ixora parviflora* Vahl. The cultivated fields were bordered by shrubs like *Azima tetracantha* Lam., *Plectronia parviflora* Bedd., *Lantana aculeata* L., and *Ehretia mycrophylla* Lam. The Bayas nested around wells and canals fringed by trees like *Syzigium jambolanum* DC., *Ficus religiosa* L., *Phoenix sylvestris* Roxb., and *P. farinifera* Roxb.

Two crops of paddy were regularly raised from August-September to January-February and from December-January to April-May. Bajra (*Pennisetum typhoideum* Rich.) and ragi (*Eleusine coracana* Gaertn.) were regularly cultivated from July to September and from January to March. Ragi was grown at other times also. Jowar (*Sorghum* sp.) and Italian millet or korra (*Setaria italica* Beauv.) were cultivated once or twice between January and September. Sugar cane and betelvine were grown as rotation crops. The grasses *Echinochloa* (varieties *colona* Link and *crus-galli* Beauv.) accompanied crops of paddy. *Panicum repens* L. *Paspalum scrobiculatum* L., and *Digitaria marginata* Link. grew along the

bunds in paddy-fields and *Brachiaria ramosa* stapf in fallows.

Methods of study

In the study area the Baya is resident throughout the year and locally considered to be a pure pest. I studied the following aspects of the biology of this bird.

1. *Feeding habits and behaviour*

Bayas were observed in the field with the help of binoculars about seven times per month for one full year for durations of 1-4 hours at different times of the day and in different spots of the study area. Details of the patterns of feeding of individual birds, the size and structure of flocks, patterns of roosting and waking, and the seasonal changes in the feeding habits were noted.

2. *Food in stomachs and crops*

From 1968 March to 1969 February some 30-40 samples of adult Bayas were collected every month from communal roosts in the study area. By mist-netting only in the evenings it was possible to obtain birds with food in their crops for examination of the contents. The birds were dissected at the base camp and the contents of their crops and stomachs washed with water and dried in the open air. The different items of food were weighed and monthly summaries of their proportions by dry weight prepared. Seeds were identified at the Systematic Botany Section of the Tamil Nadu Agricultural University, Coimbatore. Plants collected in the study area aided the identification.

3. *Examination of living birds*

The living birds netted for ringing were examined through the transparent skins of their crops and their contents noted.

4. *Experiments on captive Bayas*

Several feeding experiments were done on captive Bayas freshly caught from the wild to test their capacity for consuming seeds of paddy and *Echinochloa* spp., and their preference for different types of grains. Adult Bayas of both sexes were tested in two sets of five each housed in plywood and wire mesh cages 37.5 × 37.5 × 114.5 cm in size for ten continuous days. Each morning a fresh weighed quantity of grains was placed in the cage and each evening the remainder removed cleaned dried and weighed. To see if the easy availability of water influences the uptake of grains a control set was given only limited quantities of water.

5. *The food of the nestling Baya*

In day-long observations at different nests in 1970, the frequency of visits by parents with food and the type of food brought to feed the nestlings were noted. Stomach contents of 53 nestling birds were analysed and the different items identified.

6. *Age and appearance of the Baya*

To correlate appearance of the birds with their age birds of different age-classes (from the nestling to adult) were ringed and released and many of the ringed birds retrapped and examined again. Details of the colours of bill and plumage, and the pattern of moult of feathers, were examined in 1545 living birds and 531 preserved specimens. The peculiarities of plumage of each bird were noted down.

7. *Breeding ecology*

In a tract of about 282 ha. in the study area, the life-history of the Baya from egg to first breeding was worked out. Loss of eggs and nestlings, annual turnover of young and their pattern of dispersal were studied. The numbers of adult birds, active nests, new nests under construction and breeding males of this tract counted once a week from June to October, 1970, served as indices to their population.

8. *Status and local movements of the Baya*

Birds were netted and ringed regularly in the communal roosts and breeding colonies of the study area. As far as possible the ringed birds were released at the points of capture.

RESULTS

Feeding habits and behaviour

The Baya is resident in the cultivated parts and scrub-jungles of Rajampet throughout the year, breeding from mid April to mid November. From December to early April the birds are commonly met with in flocks numbering upto 200, feeding on freshly sown seeds and/ or standing crops of paddy and millets from the milky stage on. During this period they feed in two distinct sessions from about 6-9 hrs. and 15-18 hrs. The hotter parts of the day are spent in shady mango orchards and betel-vine gardens. These day-roosts are important to the Bayas as bases for feeding operations and for co-ordinating the movements of flocks. From one such large midday roost (near Reddipalli) the Bayas were many times observed moving through the interiors of long thickets of Lantana and Ber growing between the cultivated fields. From such perching posts the birds dropped surreptitiously into the unguarded parts of the field, and unless detected fed for periods of upto 15 minutes. The return movements to the roosts after feeding were very stereotyped also, and almost the reverse of the pattern of moving to feed. Sticking to this pattern helped in coordinating the movements of the group, concealing their activities and in moving to safety in case of attacks by watchers. During the breeding season feeding flocks contained upto 40 individuals and feeding was done throughout the day.

While feeding in freshly sown or harvested fields with stubble standing, the Bayas moved in conspicuous waves. Two or three hundred birds formed broad closely-packed rows parallel to the bunds and covered sections of the fields hopping picking grains some flying back to perches and some leap-frogging to positions in front producing the effect of a wave. Ward (1965) has described a similar feeding movement in queleas as 'roller feeding'.

Grains of paddy, grasses and Italian millets were dehusked before swallowing. Bajra, jowar and ragi were split but bajra and ragi were also swallowed whole. The Bayas drank water from the canals and ditches.

Between January and February the harvesting of paddy was completed and ragi planted in the study area. Bayas fed at this time from the standing crops and/or stubble of paddy and roosted during the nights in sugar cane. In April ragi, jowar and korra were available as food. Canes were cut by late April and the Bayas roosted in scrub jungles and reeds. In May the breeding activity of the Bayas reached a peak, and paddy was their chief food. By late June harvesting of paddy was over and bajra planted. The birds continued breeding depending on grains found on threshing floors and in stubble fields, and those growing wild in swamps and on bunds. Bajra reached the milky stage by early July and was thereafter an important food item till October. By September sugar canes grew to heights of over 2 m and the birds roosted on them. The Bayas stopped breeding in November, when if the rains were good, paddy would be available in various stages; if not, the birds consumed large quantities of Panicaceae grass seeds. The farmers who had pumps cultivated paddy throughout the year, in isolated plots. The ground feeding doves, parakeets, munias, sparrows and weaver birds attacked these crops.

The contents of stomachs and crops

Table 1 lists the food of the adult Baya revealed in stomachs and crops. Paddy 65 per

cent (by dry weight) bajra and weed seeds of Panicaceae (12% each) were consistent items. Among the grass seeds, *Echinochloa crus-galli, E. colona, Panicum repens* and *Brachiaria ramosa* were items most frequently eaten. These were the seeds which were available for a greater part of the year in the area of study. The dominance of cultivated grain in the food of the Baya was expected since the uncultivated areas of foraging, even though vast, had little growth of grass due to scanty rainfall. Table 2 gives the occurrence of certain types of food in the stomach contents of the Baya in different months and figure 1 represents the percentage composition by dry weight of various items taken on a monthly basis. The sexes were not considered separately as the differences in contents were minor. During the breeding season the stomachs of female birds showed more animal items particularly bits of shells of mollusca. Animal items with rare exceptions formed less than 5 per cent of the stomach contents. This may be due to the small size of the samples examined each month.

Table 1

Various types of food in 503 samples of stomach contents of adult Bayas examined at Rajampet from February 1968 to March 1969

Item	Frequency	Percentage
Sorghum sp.	2	Traces
Setaria italica	4	0.12
Pennisetum typhoideum	105	11.9
Eleusine coracana	15	0.45
Oryza sp.	303	65.2
Cyperaceae (weed) seeds		
Fimbristylis miliacea	10	0.6
Panicaceae (weed) seeds	192	11.6
Panicaceae seeds Break-up		
Digitaria marginata	1	
Brachiaria ramosa	35	
Paspalum scrobiculatum	13	
Paspalidium flavidum	7	
Echinochloa colona/crus-galli	36	
Panicum repens	38	
Other Panicaceae seeds	91	
Anisomeles indica	2	Traces
Animal parts	72	3.2
Break-up of animal parts		
Mollusca (shells)	31	
Orthoptera (Grasshopper)	1	
Coleoptera, Carabidae, Scarabaeidae	21	
Scolytidae	3	
Lepidoptera caterpillars	13	
Hymenoptera	3	
Arachnida: Spiders, Salticidae, Lycosidae	3	

Among the cultivated grains jowar and Italian millet formed only minor parts in the Baya stomach contents, and hard-coated grains of jowar were never seen in the adult Baya. These

TABLE 2

SEASONAL CHANGES IN THE DIET OF THE BAYA AT RAJAMPET 1968-1969

	March 1968	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April 1969
Oryza (Paddy)	+	+	+	+	+	+		+	+	+	+	+	+	+
Pennisetum (Bajra)				+	+	+	+	+	+					
Elesuine (Ragi)	+	+											+	
Setaria (Korra)							+	+	+				+	
Sorghum (Jowar)							+					+		+
Paspalum scrobiculatum									+	+				
Paspalidium flavidum										+	+	+		
Echinochloa sp.		+	+		+				+	+	+	+	+	
Panicum repens	+	+	+				+	+	+	+	+	+	+	
Brachiaria ramosa	+	+							+	+				
Fimbristylis							+	+	+	+	+			
Coldenia procumbens							+				+	+	+	
Digitaria marginata	←		Breeding	season		→	+							
Anisomeles indica											+	+		
Coleoptera						+	+	+	+	+	+	+		
Orthoptera			+											
Mollusca			+	+	+	+	+	+	+					
Arachnida			+	+		+				+	+			
Lepidoptera					+				+	+	+			
Camponotus							+				+	+	+	

+ = Eaten in that month

two millets were not extensively or regularly grown in the main area of collection. Jowar was taken in the milky stage whenever this crop was available.

Feeding experiments on captive birds

(a) Capacity of the Baya for seeds of paddy and grass. Ten adult birds with an average bodyweight of 21.2 g consumed during a ten-day trial from 21 to 30 April 1969, 3.1 g dry paddy per bird per day or 0.15 g paddy per gram body weight per day. In a similar trial from 12 to 21 October 1970 with seeds of *Echinochloa colona* and *E. crus-galli* an adult bird with an average weight of 20.4 g consumed 3.4 g moisture-free seeds or 0.166 g per gram body weight per day.

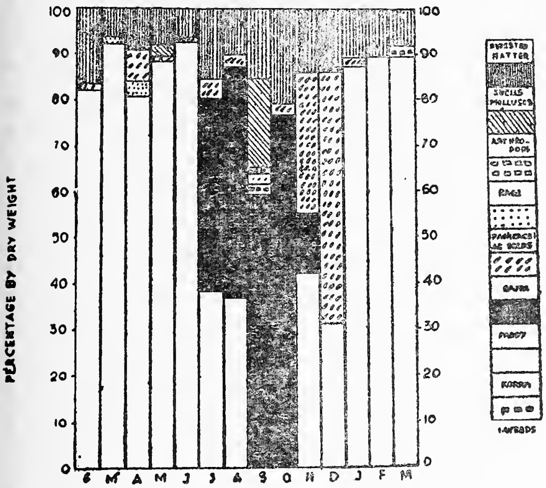


Fig. 1. Monthly changes in the stomach and crop contents of Bayas collected at Rajampet from February 1968 to March 1969.

(b) Preference of the Baya for different types of grains. From 7 to 16 July 1970, two sets of adult Bayas were offered equal quantities of paddy, bajra, korra and ragi. The birds preferred paddy 16.9 and 43.13 per cent and korra 46.92 and 69.3 per cent by weight. When the experiment was repeated with grains of *Echinochloa* spp. also added, the order of preference was: paddy 34.38 and 40.71 per cent (in two different sets); korra 35.96 and 36.3 per cent and *Echinochloa* spp. 14.45 and 23.25 per cent. These tests show that the Baya does not feed exclusively on paddy, but given the choice will consume seeds of Italian millet and *Echinochloa* as well. The Baya has a low preference for hard-coated seeds of bajra, and ragi. The quantity of water provided did not affect the uptake of grains by the captive birds.

Food of the nestling Baya

In the food given to the nestlings by the parents during four days, grasshoppers formed 33.3 per cent (by numbers), caterpillars 20 per cent, spiders 11.8 per cent, and grains 9.1

TABLE 3

FOOD OF THE NESTLING BAYA COLLECTED AT CUDDAPAH, PALGHAT AND MALAPPURAM DISTRICTS

Item	Percentage Wet weight
Oryza sp.	22.37
Pennisetum typhoideum	0.07
Sorghum sp.	1.16
Seeds of *Borreria, Coldenia, Lantana*	0.26
Mollusca (shells)	3.16
Spiders	0.30
Grasshoppers	34.89
Caterpillars	3.13
Pupae and other larval forms	1.05
Digested (unidentified plant and animal) matter	33.98

Animals identified from nestling stomachs

Spiders: Lycosidae, Oxyopidae, Thomisidae, Argiopidae

Grasshoppers: *Oxya velox, Epacromia dorsalis, Tryxalis turrita, Conocephalus* sp., *Chrotogonus* sp., *Acridium* sp.

Crickets: *Trydactylus* sp. *Gryllus* sp.

Cockroach: *Phyllodromia humbertiana*

Termite: *Eutermes* sp.

Caterpillars: *Boaris* sp., *Ismene* sp., *Papilio* sp.

Flies: Maggots of *Eristalis* sp.

Beetles: Tenebrionidae, Carabidae, Chrysomelidae

per cent. About one third, by wet weight, of the stomach contents of the 53 nestlings dissected could not be identified. In these (Table 3) grasshoppers formed 34.9 per cent, grains of paddy 22.4 per cent, and caterpillars 3.1 per cent. The adult birds collected the food from the rice fields close to the nesting colonies.

Age and appearance of the Baya

1. *Nestling, male and female*

In the nestling the feathers of the upper parts are broadly edged rufous in place of the fulvous edges of the adult birds. The breast of the nestling is strongly tinged rufous and the bill is flesh coloured with the skin of the gape thick and yellow.

2. *Juvenile male and female*

In the newly fledged Baya (1-2 months old) the feathers of the upper- and underparts retain their strong rufous tinge. The very young juveniles have down sticking to the ends of their feathers. The skin of the gape is thick and yellow and the bill is flesh coloured. These two characters disappear by the time the juvenile is 2-3 months old so that the bird now has the same appearance as the adults in the off season. From November to almost the end of February the Baya population contains juveniles, first year birds, and adults in off-plumage, all having plumage and bills of more or less the same colour. Older juveniles of 3-6 months cannot be separated from the adults in off plumage.

3. *First-year males during the breeding season*

During the breeding season, the first-year males may or may not be in nuptial plumage. An 11-month old male (ringed as nestling) had a female type of plumage but a dark bill. A ringed male recaptured at the age of 15 months had donned complete nuptial plumage and had a dark bill.

4. *First year female during the breeding season*

The female Baya breeds in its first year and has the same appearance as the older females.

5. *Adult male in prenuptial, nuptial, and postnuptial plumages*

At the time of the prenuptial moult the male Bayas which change from brown to golden on the head and breast and fulvous to blackish-brown on the chin and throat, show a mixture of all the respective colours. Beginning at the base of the bill, golden yellow feathers replace the fulvous-edged brown feathers of the crown. The blackish brown feathers appear here and there on the throat, and golden feathers on the breast. The bill turns from yellowish horn to blackish brown. Adult males in full nuptial plumage are found between mid April and November. In this plumage the crown, nape, breast and sides of the neck are golden yellow, and the bill chin and throat blackish brown. The feathers of the back, rump, and wing-coverts are dark brown in the centre and edged with fulvous. The abdomen and flanks are fulvous and sometimes washed with yellow. The rump also has a few yellow feathers. At the close of the breeding season the crown appears very pale due to fading. Brown feathers replace golden ones of the crown, beginning at the base of the bill. The chin and throat show a mixture of blackish brown and fulvous, and the bill becomes yellowish horn. In the off-plumage the adult male has the same appearance as the adult female.

6. *Adult female*

In the breeding season as well as in the off-season the female has brown upperparts with feathers edged fulvous-white, and fulvous underparts. The bill is horny yellow. The breeding female develops a brood patch. In two exceptional cases breeding females showed a yellow wash on the feathers of the breast and head.

Adult Bayas moult their body feathers twice in a 12-months period before and after breeding, in the prenuptial and postnuptial moults. The flight feathers, namely the remiges and rectrices, are changed only once in a 12-month period, i.e. after the breeding activities are over.

Breeding ecology

During the breeding season in 1970, i.e. from April 14 to November 12, 347 nests were examined. Evidence from ringed birds showed that a female Baya breeds when it is 12 months old. In exceptional cases a male may be ready to breed when 12-15 months old. Clutch size varied from 2-5 eggs the most frequent being of three. There was evidence from ringed birds that an adult male Baya raised three broods or more during a breeding season. From indirect evidence it was inferred that a female Baya raised more than 2 broods in one season. The female alone incubated the eggs and brooded the young. The incubation period was 14 days and the nestling period between 13-19 days. The males helped the females in feeding the young in some cases. Losses of eggs and young were heavy during the rainy season. In 290 nests 54.1 per cent of the eggs hatched and 18.4 per cent produced flying young. The breeding rate per adult bird was estimated as 1.6 fledgling, and increase in biomass 7.95 kg (wet) Baya for about 282 ha. This was out of 4.66 kg eggs laid in the whole season. Human interference, heavy rains, and munias nesting in breeding colonies of the Baya were known to have destroyed eggs and nestlings.

An estimate of the harmful and useful activities

From June to October 1970, a maximum of 119 adult males and 88 females were counted in the 282 ha tract. Based on these figures some crude estimates of the economic effects of the activities of the Baya were made. According to figures obtained in the locality, the study area could produce 86,994 kg of dry paddy between July and October. From feeding experiments on captive adult Bayas, like those referred to earlier, it was found that a bird weighing an average of 22.5 g took 3.62 g of dry paddy per day. Assuming that all the 207 adult Bayas had stayed in the area and fed only on paddy produced there for 4 months from 1 July to 31 October at the above rate, the maximum possible damage by them would equal 94.8 kg which is 0.11 per cent of the paddy produced in this area during this time. By similar calculations based on feeding rates of captive birds and feeding behaviour observed in nature, it was estimated that a flock of 186 Bayas could have eaten 3.86 kg (dry) of panicaceae weed seeds from the study area in December 1968. It was found that during the last 3 or 4 days of nestling-life the weights of the nestling Bayas did not change much. If all the nestling Bayas which left nests in the 1970 breeding season in the study area were fed by their parents at observed rates they would have destroyed 9268 or 2.8 kg (wet) grasshoppers and 10771 caterpillars in the last three days of their nestling-life. When the abundance of the grasshoppers in the study area was also considered, the fraction destroyed by the Bayas alone was probably negligible. On the average 128 grasshoppers were counted in the paddy field of the study area in five minutes in 19 observations in 1970. These are only very rough estimates. At the present population density, the Bayas of the area could not be doing serious damage or significant service to standing crops.

Status and local movements

During the years 1968-1971, 460 nestling Bayas and 1085 older birds were ringed. These

birds were trapped in nets or taken from nests in some of the 30-40 breeding colonies, and also netted from the roosts in the four sugarcane fields of the study area. Thirteen ringed as nestlings and 60 of the older birds were retrapped. Nine of the former were recaptured within 1-8 months of nest leaving, from the roosts of adults in sugarcane. This showed that these roosts were important to the newly fledged Baya. Twenty-two first year and older birds originally netted and ringed at one roost were retrapped at the same roost between intervals of two weeks to two years after ringing. Netting at different roosts in the area showed that some of the Bayas changed roosts within a single season. Bayas ringed at one roost were recaptured at breeding colonies in five adjacent hamlets and villages at distances of 1-2 km from the roosts. There were also a few cases of the Bayas ringed in feeding grounds in the rice fields recaptured at the roost in sugarcane. Recaptures of the Bayas ringed at breeding colonies showed that the breeding Bayas did not move very far and probably bred in the same area, if not at the same colonies, year after year. Five Bayas ringed as nestlings in the breeding season 1970 were recaptured breeding in 1971 in colonies 10 m to 4.8 km distant from the colonies where they were raised. Thus the recaptures of ringed birds showed that the Baya was a resident in the study area, and moved about locally within a distance of 2-5 km from its breeding area. The practice of growing sugarcane near fields of paddy was very favourable to the Baya. These roosts provided protection at night, coordinated the movements of the newly fledged and adult birds, and probably helped the Bayas in locating good sources of food and breeding sites.

Discussion

The ecology and biology of the Baya were studied in detail in order to understand its economic status. Eventhough the Baya is popularly believed to be a pest of grain crops no systematic study of its feeding habits had been done in any particular area. Rajampet taluk proved to be ideal for such a study. The environmental conditions here were rigorous. Paddy, the main food of the Baya and ragi were grown throughout the year, and other grain crops like bajra, jowar and Italian millet at least once a year. The stomach contents of the Bayas collected in Rajampet over a period of a year showed paddy (65%), bajra and Panicaceae weed seeds (about 12% each) as the consistent items. In November and December when cultivated crops were few, Panicaceae weed seeds formed 38 and 52 per cent. Preference tests showed adult Bayas preferring seeds of paddy, Italian millets, and weed seeds *Echinochloa* spp. from a choice of 5 including bajra and ragi also. The predominance of paddy in the Baya's food could be due to the fact that paddy is the main crop of the study area. The fact that seeds of Italian millet and *Echinochloa* were also preferred points to the possibility that the smaller Panicaceae seeds were the traditional food of Plocid birds and that in areas where paddy is not so extensively grown the Baya consumes more of Panicaceae weed seeds. The low preference of seeds of ragi is significant. This may perhaps be a means of ecological adjustment with the ground feeding doves of the area which take ragi in large quantities. It is clear from this study that grasshoppers and caterpillars from a major part of the food given to nestlings by the adults.

Attacks on standing crops of paddy by the

Bayas were often based in the mango orchards situated near rice fields and concealed by the thickets of lantana, ber, and neem bordering fields. The Bayas exploit the local layout of crops very efficiently, particularly the combination of paddy and millets with sugarcane and betel vine grown nearby. The latter crops provide ideal roosts and places of assembly for the birds of all age-classes and very safe refuges for the fledglings, and the adults weakened by the rigours of a breeding season and heavy moult. When the sugarcanes were cut the movements of Bayas were disorganized and they were forced to roost in less safe places like scrub jungles and reeds.

Clearing of the bordering bushes and changing the layout of crops so as to eliminate the safe bases, mid-day and nightly roosts may prove effective measures of prevention in areas where the Baya is a pest.

Examination of ringed birds shows that it is possible to identify the different age-classes of the Baya in the field during the breeding season. This is the period when a meaningful census of the birds may be done. In the post breeding period the subadults, first year birds, older juveniles, and the adults of both sexes, all have the female type plumage. It is difficult to judge the age of the Baya at this time.

Very low nesting success inspite of a long breeding season is an economically important feature about the Baya's breeding biology. In collecting caterpillars and grasshoppers from paddy fields for its young the adult Baya does definite service to agriculture. High rates of loss of eggs and nestlings check the size of the Baya population. At the present population level of less than one adult bird per ha, the Baya may not do any serious damage to standing crops in the study area. Yet many farmers reported that the Bayas were causing large scale destruction of their crops. In every case study on the spot revealed that the area attacked was an isolated tract where paddy had matured much earlier than in the adjacent fields. Such plots attracted doves, parakeets, munias and sparrows and suffered much damage. By planting and harvesting in unison with general practice of the area, excessively large concentration of granivorous birds in small plots may be avoided. Cultivation of grain crops in the off season in isolated plots may be necessary to increase the production of food, but it is incorrect to blame any particular species of bird for the damage suffered by such plots. Only by careful observation in the field during different parts of the day can one determine which species of birds are actually involved.

Since the population size of the Baya in the study area was too low to do either serious damage or significant service to agriculture its economic status there should be described as neutral.

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Dietary habits of rhesus monkeys (*Macaca mulatta* Zimmermann) in Indian forests[1]

D. G. Lindburg[2]

A year's study of rhesus monkeys in forest habitats in north India revealed that the diet is largely frugivorous, but also includes a variety of leaves, stems, flowers, buds, and insects. There was no evidence of feeding on animal matter other than insects. The diet varies considerably on a seasonal basis, due to changes in food availability. Regional differences in diet may be primarily a consequence of regional variation in available food plants.

Although the rhesus monkey has been studied in its natural habitat by a number of investigators in recent years, as yet no detailed information on dietary habits has been reported. The species occupies a wide range of habitats in present-day India (Southwick, Beg, & Siddiqi 1965; Neville 1968; Mukherjee 1969), but is by nature a forest adapted animal. I conducted a field study of two populations in 1965-66, one located in forest parcels at the Forest Research Institute in Dehra Dun, and the other in the nearby Asarori forest, located on the north slopes of the Siwalik Hills. Descriptions of these habitats and many facets of rhesus monkey behaviour have previously been published (Lindburg 1971). I present here unpublished data on the dietary habits of these two populations.

The monkeys at Asarori were observed for a 12 month period, beginning in June, 1965. Data for the FRI population were collected over a nine month period, beginning in August, 1965. Botanic samples of plants used as food were routinely collected and preserved for later identification by the FRI staff in Dehra Dun. Estimates of the importance of different items in the diet were based on numbers of individuals feeding on a particular source and the relative length of feeding periods.

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The Asarori Population

The monkeys in the Siwalik forest occupied portions of the Asarori, Laldhang, and Mohamadpur blocks, as shown on Survey of India maps of the region. A portion of the range of these monkeys extended into privately owned forest near the village of Mahobiwalla. Records of the Dehra Dun Forest Division for the reserved part of the range (Nath 1963) indicate a predominance of relatively immature *Shorea robusta* Gaertn. in this region of the Siwaliks, but substantial areas are taken up by *raos* and by mixed inferior forest (Table 1). Those sections of the forest bordering along *raos* proved to be important feeding areas during the latter part of the dry season and throughout the monsoon months, whereas the

winter range was located primarily within the mixed inferior forests of the region.

The rhesus monkeys at Asarori were predominantly vegetarian in their feeding habits. They utilize a wide range of trees, shrubs, climbers, grasses, and herbs. Table 2 presents a complete list of all plant foods consumed at Asarori, the portions preferred, and the months of the year in which they were utilized. While

TABLE 1

MAIN TYPES OF COVER IN THOSE PORTIONS OF THE ASARORI, LALDHANG, AND MOHAMADPUR BLOCKS USED BY THE SIWALIK STUDY POPULATION

Type	Per cent
Shorea robusta, 85 to 95 ft high	40.3
Shorea robusta, 75 to 85 ft high	29.9
Shorea robusta, 65 to 75 ft high	23.4
Mixed forest, no commercial value	1.6
Grassland, eroded stream beds	4.8
Total	100.0

a wider variety of leaves was exploited than of any other portions, estimates of quantities consumed indicated that wild fruits accounted for nearly 70 per cent of the total diet. The most heavily used fruits, in decreasing order of importance were: *Shorea robusta* Gaertn., *Syzygium cumini* (L.) Skeels., *Grewia elastica* Royle, *Phoebe lanceolata* Nees, *Ehretia laevis* Roxb., and *Carissa spinarum* A. DC.

These fruits varied greatly in their seasonal availability, except for a few days' overlap in the occurrence of *Grewia* and *Phoebe* after the monsoon, and the simultaneous appearance of *Shorea* and *Ehretia* during the dry season. No wild fruits were available during the greater part of August. In the winter season, limited quantities of the fruits of *Carissa* and of *Cudrania javanensis* Trecul. were consumed, but at this season the diet became much more variable, consisting of a variety of leaves, grasses, and herbs (note the variation in number of different food plants consumed per month in Table 2).

We confirmed Roonwal's (1956) observation that rhesus monkeys voraciously consume wild mushrooms, mainly during the month of August. "Puffballs" of the genus *Scleroderma* were similarly sought from October into December. When feeding on the leaves of *Cudrania javanensis* Trecul., the monkeys showed a distinct preference for those which had been attacked by a fungus. Gupta (1962) notes that such leaves, called *mande-ki roti*, are often used as food by humans.

Included among the food plants of the monkeys' diet are some which are known to have toxic properties. For example, the seeds of *Abrus precatorius* Linn. were regularly eaten, apparently without adverse effects, even though they are reported to cause death in humans and animals (Gunn 1969), and are used in India for poisoning cattle and humans (Chakravarthy 1969). The fruits of *Casearia graveolens* Dalz. and *C. tomentosa* Roxb. are used to poison fish (Gupta 1962), but as far as we could determine, the monkeys ate only the leaves of these two plants. A number of other items in the diet are used in folk medicine, and possibly are toxic if consumed in sufficient quantity.

Insects such as hoppers, ants, termites, and beetles were consumed in small quantities in all months of the year. The abundant population of peafowl and red jungle fowl at Asarori is indirect evidence that eggs are not a part of the monkeys' diet. To test this possibility, we placed hen's eggs in an area where we

TABLE 2

FOOD PLANTS UTILIZED BY RHESUS MONKEYS IN THE SIWALIK FOREST AT ASARORI

Species	J	J	A	S	O	N	D	J	F	M	A	M	Part consumed
GRASS													
Arundinella nepalensis Trin.										X		X	Stem
Capillipedium hugelii Hack.						X	X		X				Seed
Digitaria setigera Roth.*		X	X	X	X	X	X	X	X				Seed
Oplismenus compositus Lam.					X							X	Seed
HERB													
Aerides multiflorum Roxb.						X	X	X	X	X			Whole plant
Ageratum conyzoides Linn.*							X	X					Stem, flower
Argemone mexicana Linn.										X			Flower
Cassia tora Linn.						X							Seed
Colocasia esculenta (L.) Schott.			X										Stem, leaf
Commelina obliqua Ham.							X						Leaf
Datura alba Nees.								X					Pith of stem, leaf
Dioscorea belophylla Voigt.*						X	X	X	X				Leaf, seed
Drymaria cordata Willd.								X					Whole plant
Galium triflorum Michoc.*								X					Whole plant
Globba racemosa Smith.		X	X	X	X	X							Stem
Moghania bracteata Roxb.									X				Seed
Oxalis corniculata Linn.								X	X				Whole plant
Parilla ocymoides Linn.						X							Seed
Rumusatia vivipara Scholt.			X	X									Stem
Stellaria media (L.) Cyrill.*							X		X	X			Whole plant
Zinziber roseum Roxb.							X	X					Flower
CLIMBER													
Abrus precatorius Linn.*		X	X	X		X	X	X	X				Leaf, seed
Aspidoterys wallichii Hook. f.				X									Leaf
Atylosia crassa Prain.						X	X	X	X				Leaf
Bauhinia vahlii W. and A.							X						Stem (new growth)
Melotheria heterophylla Cogn.				X									Stem, leaf
Milletia auriculata Baker							X		X	X	X	X	Pith of stem, root
Porana paniculata Roxb.						X	X		X	X			Leaf
Rhaphidophora glauca Schott.							X						Leaf
Scindapsus officinalis Schott.								X					Fruit, bark
Smilax indica Vitm.							X	X	X				Pith of stem, leaf, fruit
Spatholobus roxburghii Benth.						X	X	X	X	X	X	X	Pith of stem, leaf
Ventilago calyculata Tulasne.*							X	X					Pith of stem, leaf
Zehneria umbellata Thev.									X				Stem
SHRUB													
Aerua scandens Wall.													Leaf
Agave wrightii D. and P.		X							X				Leaf

TABLE 2 (*continued*)

Species	J	J	A	S	O	N	D	J	F	M	A	M	Part consumed
Antidesma diandrum Roth.						X	X	X	X				Leaf
Ardisia solanacea Roxb.							X	X					Stem, leaf, fruit
Carissa spinarum A. DC.*						X	X	X	X	X			Pith of twigs, fruit
Cudrania javanensis Trecul.*			X	X	X	X	X	X	X				Leaf, fruit
Desmodium latifolium DC.									X				Leaf
Ficus clavata Wall.							X						Leaf
Gongronema nepalensis Dcne.							X						Leaf
Gymnema tingens W. and A.							X						Fruit
Indigofera pulchella Roxb.										X			Leaf
Jasminum multiflorum (Burm. f.) Andr.*						X	X	X	X	X	X	X	Stem, leaf, flower
Lantana camara Linn.*			X				X						Fruit
Murraya exotica Linn.				X					X	X			Leaf, fruit
Murraya koenigii Spreng.*				X					X	X			Leaf, fruit
Opuntia dillenii Haw.	X							X		X	X		Leaf
Pueraria tuberosa DC.		X	X										Flower
Randia dumetoram Lamk.*							X	X	X		X		Leaf, bark
Rubus lasiocarpus Sm.*	X					X	X	X	X	X	X	X	Leaf
Solanum hispidum Pers.*						X							Pith of stem, fruit
Zizyphus jujuba Lamk.*							X						Fruit
TREE													
Acacia catechu Willd.										X			Seed
Aegle marmelos Correa.							X						Fruit
Albizzia lebbek Benth.*							X						Leaf, seed
Bauhinia malabarica Roxb.				X	X								Leaf, seed
Bauhinia variegata Linn.											X		Flower
Bombax malabaricum DC.*								X		X			Leaf, seed, flower
Buchanania latifolia Roxb.		X											Fruit
Butea monosperma Lamk.							X	X		X			Pith of twig, flower
Careya arborea Roxb.	X												Pith of twig, fruit
Casearia graveolens Dalz.												X	Leaf
Casearia tomentosa Roxb.												X	Leaf
Cordia myxa Linn.	X												Fruit
Dalbergia sissoo Roxb.*										X			Leaf, seed, bud
Ehretia laevis Roxb.										X	X	X	Fruit
Eugenia operculata Roxb.				X			X						Fruit
Ficus cunia Ham.												X	Fruit
Ficus religiosa Linn.*									X				Leaf
Ficus roxburghii Wall.							X	X	X	X	X		Pith of twig, fruit
Firmiana colorata R. Br.							X						Pith of leaf stem
Grewia elastica Royle			X	X	X								Fruit
Kydia calycina Roxb.				X									Leaf
Lagerstroemia parviflora Roxb.						X							Fruit

TABLE 2 (*continued*)

Species	J	J	A	S	O	N	D	J	F	M	A	M	Part consumed
Mallotus philippinensis Muell.*					X	X							Stem, fruit
Markhamia platycalyx Sprague.										X			Leaf, flower
Miliusa velutina H. f. and Th.								X		X	X		Leaf, flower
Ougeinia dalbergioides Benth.										X			Leaf, flower
Phoebe lanceolata Nees.				X	X	X							Fruit
Pyrus pashia Ham.*					X	X	X						Fruit
Semecarpus anacardium Linn.			X				X						Pith of twig
Shorea robusta Gaertn.*	X	X	X		X	X	X	X	X	X	X	X	Pith of twig, leaf, flower, fruit, bud, shoots
Sterculia pallens Wall.						X	X						Pith of leaf stem
Sterculia villosa Roxb.		X											Pith of leaf stem
Syzygium cumini (L.) Skeels	X	X											Fruit
Terminalia alata Meyne ex Roth.					X	X	X	X					Leaf, fruit
Terminalia belerica Roxb.			X						X				Resin, fruit
FUNGI													
Russula sp.*		X	X	X									Whole plant
Scleroderma sp.					X	X	X						Whole plant
Total species per month	6	10	13	15	12	25	41	29	28	24	11	11	

* Also utilized by monkeys at the Forest Research Institute.

expected the monkeys to pass later in the day. Several walked over the eggs without noticing them; others sniffed, handled, and eventually bit into the shells, then appeared startled when the yolk ran out. These behaviours clearly suggest investigation of an unfamiliar item.

The feeding activities of rhesus monkeys result in considerable damage to certain kinds of vegetation. Feeding on the tender, young leaves of *sal* seedlings, for example, results in their being completely stripped of leaves or even uprooted. The large leaf stems of species such as *Sterculia pallens* Wall. and *Kydia calycina* Roxb. were frequently broken off and peeled in order to get at the pith. Altogether, we noted peeling of stems or terminal twigs of 15 different species, including *sal*.

COMPARISON WITH THE FRI POPULATION

The monkeys at the Forest Research Institute utilized 24 of the same plant species as the monkeys at Asarori. Like other monkey groups living in close proximity to human habitation, the FRI groups were frequently fed by man, and commonly raided nearby fruit orchards, gardens, and fields. Excluding the latter from the tabulation, we found that the FRI monkeys exploited at least 45 foods not consumed by the Asarori monkeys (Table 3). Much of the difference in diets for the two populations is simply a matter of availability. Although the vegetation at FRI contains a number of naturally occurring species, it also contains many introduced species not found at Asarori.

TABLE 3

PARTIAL LIST OF FOOD PLANTS UTILIZED BY RHESUS MONKEYS AT THE FOREST RESEARCH INSTITUTE, DEHRA DUN*

Species	Part consumed
GRASS	
Saccharum spontaneum Linn.	Stem, shoot
HERB	
Launaea aspleniifolia DC.	Leaf, flower
Polygonum serrulatum Lagasc.	Flower
Pueraria phaseoloides Benth.	Stem
Rubia cordifolia Linn.	Pith of stem, leaf, fruit
Vicia sativa Linn.	Seed
CLIMBER	
Paederia foetida Linn.	Leaf
Passiflora suberosa Linn.	Fruit
SHRUB	
Camellia theifera Griff.	Stamen
Caryota mitis Lour.	Pith of stem
Clerodendron infortunatum Gaertn.	Flower, fruit, new leaf
Desmodium gangeticum (L.) DC.	Leaf
Diospyros cordifolia Roxb.	Fruit
Flemingia congesta Roxb.	Seed
Hamiltonia suaveolens Roxb.	Leaf
Hibiscus rosa-sinensis Linn.	Pith of stem, flower
Karogana chamlagu Lam.	Flower
Rauwolfia serpentina Benth.	Flower
Rhamnus virgata Roxb.	Leaf, fruit
Wistaria sinensis Sweet.	Flower
TREE	
Alseodaphne keenanii Nees.	Fruit
Aleurites fordii Hemsl.	Leaf, flower, shoot
Anthocephalus cadamba Miq.	Fruit
Bauhinia purpurea Linn.	Flower
Bischofia javanica Bl.	Fruit
Broussonetia papyrifera Vent.	Leaf, flower, fruit, shoot, pith of stem
Cedrella toona Roxb.	Fruit
Chrysophylum oliviforme Linn.	Fruit
Cinnamomum camphora Linn.	Fruit
Eriobotrya japonica Lindl.	Fruit
Ficus benjamiana Linn.	Fruit

TABLE 3 (*continued*)

Species	Part consumed
Ficus glomerata Roxb.	Fruit
Ficus palmata Forsk.	Leaf, fruit
Hovenia dulcis Thunb.	Fruit
Leucanea glauca Benth.	Leaf, seed
Litchi chinensis Sonner.	Fruit
Litsaea polyantha Juss.	Pith of stem
Mangifera indica Linn.	Fruit, flower, seed
Mimusops hexandra Roxb.	Fruit
Morus alba Linn.	Bud, new leaf, fruit
Premna latifolia Roxb.	Leaf
Prunus persica Benth.	Fruit
Psidium guyava Linn.	Fruit
Quercus serrata Thunb.	Seed
Santalum album Linn.	Fruit

* Additional food plants for the FRI population are listed in Table 2.

The principal value of the FRI data on diet is in demonstrating the range of items which may be used as food, and in further illustrating the capacity of the species to adjust its feeding habits to locally available resources, an attribute which has enabled it to survive and flourish as its original habitat disappeared.

One of the more interesting observations at FRI was the feeding on stamens of the tea plant, *Camellia theifera* Griff. In late October we began to notice a yellow substance on the faces of the monkeys, and later determined it to be pollen from the flowers of the tea plant. This pattern of feeding continued throughout November and over the first half of December.

FEEDING BEHAVIOUR IN OTHER AREAS

Very little information is presently available on dietary habits of rhesus monkeys from other regions. In Table 4 we list food plants noted in travels of forested regions in other parts of north India. The combined total of unique food plants from the three tables equals 150. Given the geographical distribution of rhesus monkeys, it is reasonable to expect that diets will vary considerably from region to region.

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TABLE 4

LIST OF PLANT FOODS CONSUMED BY RHESUS MONKEYS IN OTHER FOREST AREAS IN INDIA

Species	Where collected	Part consumed
GRASS		
Arundinella nepalensis Trin.	Corbett Park	Stem
Dendrocalamus strictus Nees.	South Kheri	Leaf
Saccharum spontaneum Linn.	South Kheri	Shoot
HERB		
Galium aparine Linn.	Mussoorie	Whole plant
SHRUB		
Berberis lycium Raf.	Mussoorie	Bud, new leaf
Carissa spinarum A. DC.	West Timli	Fruit
Ervatamia coronaria Stapf.	South Kheri	Leaf
Punica granatum Linn.	Tatura, Chandigarh	Leaf
Reinwardtia trigyna Planch.	Mussoorie	Flower
Strobilanthes glutinosus Nees.	Mussoorie	Flower
TREE		
Azadirachta indica A. Juss.	Corbett Park	Leaf
Bauhinia malabarica Roxb.	South Kheri	Seed, seed pod
Butea monosperma Lamk.	Mohand	Flower
Careya arborea Roxb.	Corbett Park	Pith of stem
Dalbergia sissoo Roxb.	Corbett Park, S. Kheri	Seed, bud, new leaf
Ehretia laevis Roxb.	Mohand	Fruit, flower
Ficus nemoralis Wall.	Mussoorie	Leaf stem
Ficus religiosa Linn.	Corbett Park	Leaf
Madhuka latifolia Gmel.	South Kheri	Bark
Pinus roxburghii Sargent	Chandigarh	Seed
Quercus incana Roxb.	Mussoorie	New leaf
Rhododendron arboreum Sm.	Mussoorie	Leaf, flower
Shorea robusta Gaertn.	West Timli	Flower

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The effects of early experience on habitat selection in tadpoles of the Malayan painted frog, *Kaloula pulchra* (Anura : Microhylidae)[1]

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(*With two text-figures*)

In this study, the effects of early experience on subsequent habitat selection by tadpoles of the Malayan painted frog, *Kaloula pulchra* (Anura: Microhylidae) were investigated. Tadpoles from laboratory-hatched eggs were reared on various artificial substrate patterns. Animals reared in white trays (featureless environment) exhibited no habitat preferences. Tadpoles reared in a stripe-patterned environment showed a marked preference for the striped substrate area of the test chamber. Similarly, tadpoles reared in a square-patterned habitat exhibited a strong preference for the squared substrate when given a choice between squared and striped substrate pattern types. It was also demonstrated that once a habitat preference had been established, it was retained even though a period of isolation from the original rearing substrate pattern. The results of these experiments indicate that larval amphibians can learn to respond to physical features of their environment and associate habitat preference responses with these features. The adaptive significance of early experience effects on habitat selection are also discussed.

INTRODUCTION

It is a well established fact that habitat selection in vertebrates is predicated upon some active response to one or more specific stimuli present in the environment (Heatwole 1961; Hilden 1965; Wiens 1970). These stimuli are frequently associated with the spatial patterning of the habitat (Klopfer & Hailman 1965). In recent years there has been an emphasis placed on the behavioural mechanisms involved in habitat selection responses, and it has been demonstrated that the effects of early experience can have significant effects upon the subsequent responses made by the organism to physiognomic features of the environment (Sargent 1965; Wecker 1963; Wiens 1972). The majority of previous studies have concentrated on mammals (Ambrose 1973; Barash 1973; Cameron & Rainey 1972; Geluso 1971; Miller 1942; Wecker 1963) and birds (Hilden 1965; Klopfer 1967; Lack & Venables 1939; Sargent 1965). With respect to amphibians and reptiles, most of the studies have focused on the physical features of the habitat (Goodman & Goin 1970; Heatwole 1962), while relatively few studies have concerned themselves

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with the processes involved in habitat selection (Heatwole 1961; McKenzie & Storm 1970; Sexton & Ortleb 1966; Wiens 1970, 1972). Prior investigations have demonstrated that adult amphibians do respond selectively to various physical features of the habitat (Sexton *et al.* 1964). However, the role of larval experience in the ontogeny of habitat preferences is not completely understood. In addition, there have been relatively few studies on the relationship between learning and retention capacities of amphibians (Chu & McCain 1969; Kuntz 1923; Munn 1940; Noble 1931; Schneider 1968; Sluckin 1965; Thorpe 1963) and their possible adaptive significance with respect to habitat selection behaviour.

In the present study, the effects of early experience on subsequent habitat selection by tadpoles of the Malayan painted frog, *Kaloula pulchra,* were investigated, as well as the retention capacities of this amphibian.

Materials and Methods of study

The *Kaloula pulchra* tadpoles utilized in this study were obtained from breeding adults in the laboratory. Mature males and females were allowed to breed and the fertilized eggs were placed in plexiglass trays containing distilled water maintained at 22°C. Immediately upon hatching, the tadpoles were individually isolated and placed in white porcelain trays. They were kept under a standard photoperiod interval (16L: 8D). The tadpoles were maintained in this manner for a period of one week after which they were divided into four groups of 90 individuals and subjected to different rearing substrate patterns for a period of two weeks. The test animals were fed on a diet of rabbit pellets.

Control group tadpoles (Group 1) were reared in a relatively sterile environment devoid of any patterning. They were kept in white trays (50 × 35 × 10 cm) throughout the experiment and were maintained in this manner at 22°C and a photoperiod of 16L: 8D.

Group 2 tadpoles were subdivided into two groups, each reared in one of two experimental habitats throughout their development. These habitats consisted of enclosed chambers (70 × 110 cm) provided with fluorescent lighting and a one-way viewing glass. Substrate patterns were produced by using black plastic tape against the white background floor of the rearing trays. One pattern consisted of black parallel stripes 2.5 cm wide and 2.5 cm apart; the other substrate pattern consisted of black squares (2.5 × 2.5 cm) arranged in a linear sequence, 2.5 cm apart.

Group 3 tadpoles were tested for two weeks as those in Group 2 and then transferred to sterile chambers devoid of patterning and similar to those of the control group for a period of one week.

In order to ascertain the effects of early experience on subsequent habitat selection, individual animals were tested for preference between the two substrate patterns discussed above. The tadpoles were placed in an enclosed testing chamber (70 × 70 cm) provided with a one-way viewing glass. Temperature, water and light regimes were identical to rearing conditions. The floor and sides of half of the test chamber were provided with a striped pattern identical to that used in the rearing habitat, while the other half of the chamber was covered with black squares (Fig. 1). A transparent plexiglass tube, 5 cm in diameter and open to both ends, was placed vertically in the centre of the chamber directly over the boundary between the two substrate patterns (Fig. 1, X). The test chamber was filled with distilled water to a depth of 8 cm.

For each trial, the tadpole to be tested was removed from its experimental habitat, placed in the vertical tube and then released into the test chamber. All experimental animals exhibited some preliminary exploratory activity followed by definitive orientation movements toward a specific substrate pattern. The choice of substrate pattern as well as the amount of time spent on each pattern during a 3-minute interval following placement in the vertical

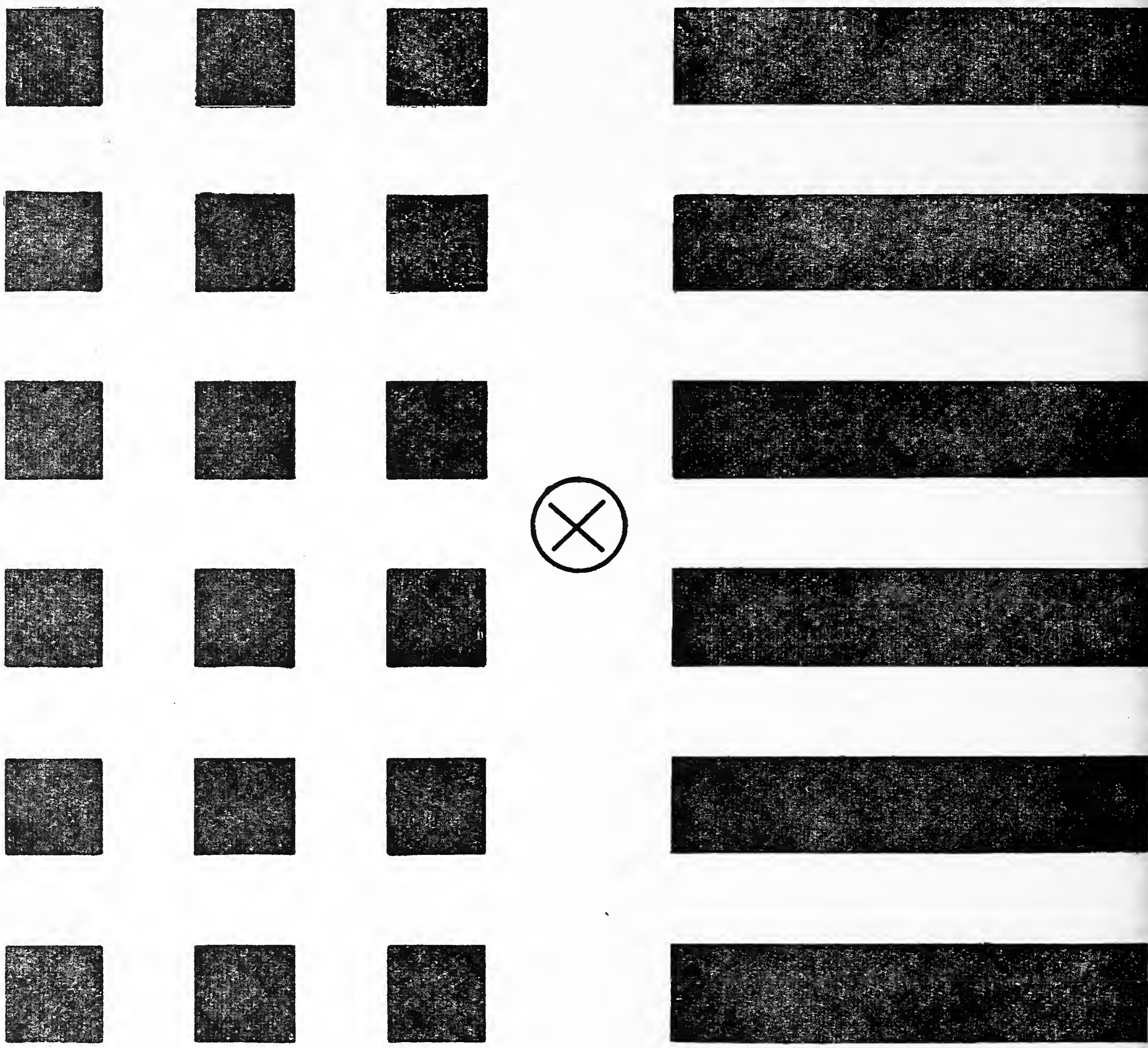

Fig. 1. Diagrammatic representation of the floor of the test chamber showing the two types of experimental substrate pattern types. (X) refers to the vertical tube placed at the boundary between the squared and striped substrate patterns.

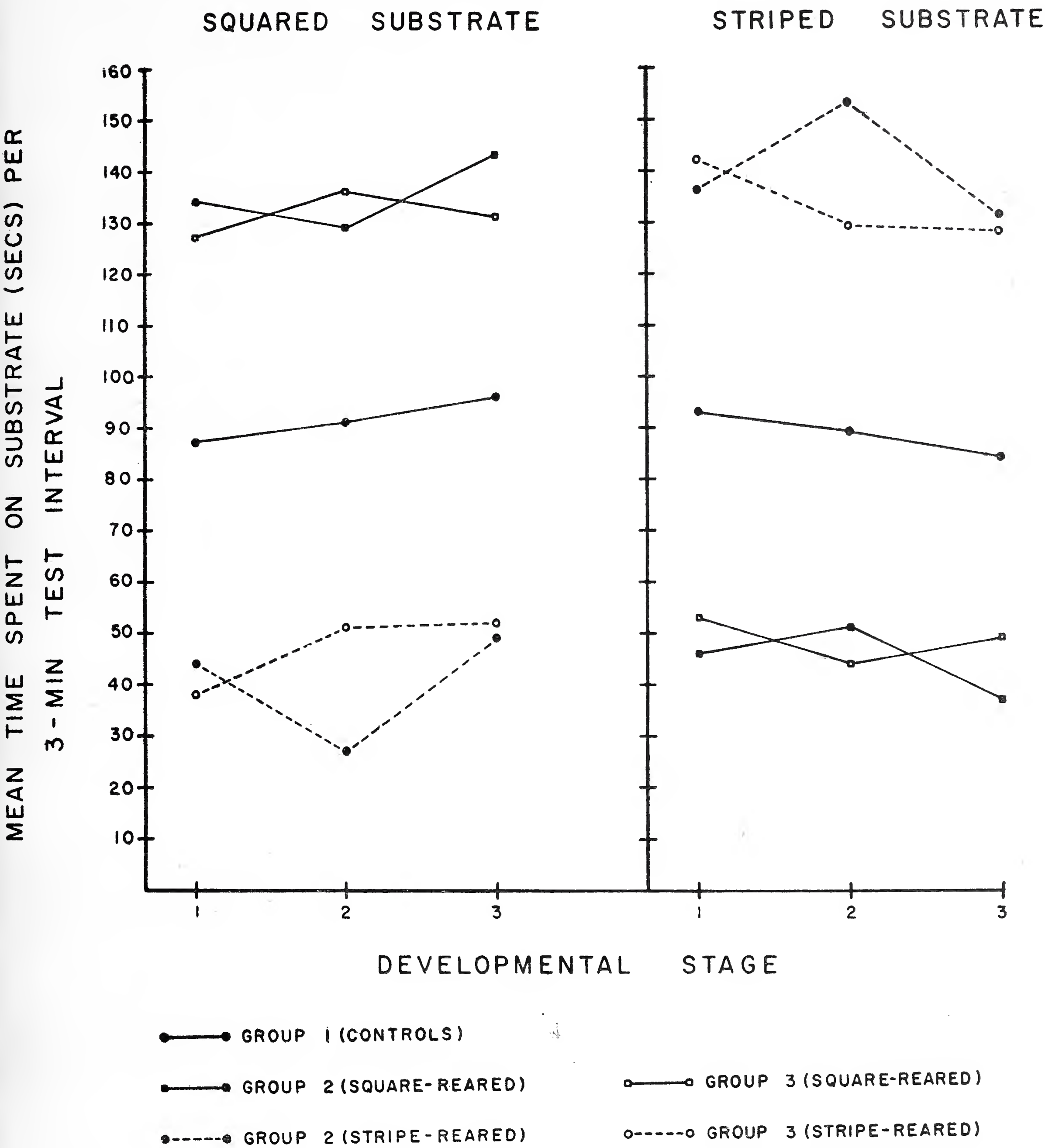

Fig. 2. Mean time in seconds spent on each substrate pattern per 3-minute test interval.

tube were recorded. Upon termination of test trials the tadpoles were returned to their rearing habitats.

Pattern preferences were analyzed at three developmental stages based on larval length in mm (Gosner 1960): (1) 10-15 mm (young tadpoles with no visible hind leg development); (2) 15-25 mm (tadpoles exhibiting hind leg development); (3) 25-35 mm (metamorphosis essentially complete with only a small remnant of the larval tail remaining).

Results

Choice of substrate pattern (Table 1) and time spent on each substrate (Fig. 2) were found to be significant indices of habitat preferences. Control animals (Group 1) showed no preference for either substrate pattern, and all three developmental stages spent fairly equal amounts of time on both patterns.

Group 2 tadpoles that were reared in a square-patterned habitat exhibited a marked preference for the square pattern area of the test chamber, both in their initial choice (Table 1) and in the amount of time spent in the square versus the stripe-patterned habitat (Fig. 2). Animals reared in a stripe-patterned habitat similarly showed a preference for the striped substrate area of the test chamber. This suggests that such preferences were established during the initial rearing periods in the squared and striped experimental habitats. Qualitative observations verify the biological significance of the above results. At all three developmental stages, the tadpoles that were reared in the squared habitat and selected the squared substrate pattern when tested, swam vigorously during the 3-minute test period. Frequently, some individuals would swim toward the boundary between the two substrate patterns. Upon reaching this boundary the tadpoles would suddenly stop and terminate locomotor activity for several seconds. After this short pause, the animals would either dart back into the squared substrate area or swim parallel to the boundary within the squared area of the test chamber. Likewise, animals reared in the striped habitat would approach the boundary within the striped section of the chamber. Occasionally, square-reared tadpoles would venture into the striped substrate area but would remain there for only brief periods and then rapidly return to the squared area. Similar observations were noted for stripe-reared tadpoles that infrequently would enter the squared area.

Group 3 tadpoles were used to ascertain whether or not an initial substrate pattern preference could be retained over a period of isolation from the rearing substrate. After having been kept in a sterile featureless environment for one week, they were placed in the test chamber. Once again, all individuals exhibited a distinct preference for the substrate pattern upon which they were reared, as indicated by their initial choice and time spent on the substrate. This indicates a definitive retention capacity for specific physical cues in the habitat.

Discussion

The results of these experiments demonstrate that *K. pulchra* tadpoles can establish preferences for substrate patterns based on physical features present in the habitat where they emerge from the egg. These effects of early experience on habitat selection are shown in Table 1 and Fig. 2. In all groups, the majority of tadpoles chose the habitat pattern that they had been subjected to upon hatching over one which was unfamiliar to them. In addition, the animals spent a great deal more

time on the substrate which resembled that of the rearing habitat. In addition to the relatively rapid acquisition of habitat preferences after hatching, these tadpoles demonstrate the capacity to retain these preferences even after periods of isolation from the substrate patterns, as well as through the developmental changes taking place during metamorphosis. Furthermore, as pointed out by Wiens (1970), the acquisition of this preference response does not appear to be characterized by a critical period during which the preference must be established as the older tadpoles established a preference as quickly as the younger animals. This suggests that the underlying mechanisms involved in the formation of preference responses are different from those which characterize imprinting behaviour. The importance of such critical periods in imprinting is discussed in detail by Bateson (1966), Bateson & Reese (1969), and Sluckin (1965).

Microhylids of the genus *Kaloula* are characterized by vertical pupils, palatine bones which form a toothed ridge across the palate, digits free or webbed, outer metatarsals which are united, precoracoids and omosternum absent, a cartilagenous sternum, and the diapophyses of the sacral vertebrae being slightly dilated (Boulenger 1890; Parker 1934; Porter 1972; Smith 1935). There are eight known species, three of which occur in the Malay Archipelago (Parker 1934). The Malayan painted frog, *K. pulchra,* ranges from Peninsular India and Sri Lanka, to Burma, southern China and the Malay Peninsula. Tadpoles used in this study were reared from adults orginally collect-

TABLE 1

INITIAL CHOICE OF SUBSTRATE PATTERNS MADE BY *Kaloula pulchra* TADPOLES REARED IN THREE EXPERIMENTAL HABITATS

Group	Rearing habitat pattern	Developmental stage	Number choosing per 30 tadpoles				z – Value	
			Squares	(%)	Stripes	(%)		
1	Sterile Environment	1	17	(56.6)	13	(43.3)	0.52	
		2	12	(40.0)	18	(60.0)	0.81	
		3	14	(46.6)	16	(53.3)	0.29	
2	Squares	1	26	(86.6)	4	(12.3)	2.65	(P<.01)
		2	21	(70.0)	9	(30.0)	2.09	(P<.01)
		3	24	(80.0)	6	(20.0)	2.48	(P<.01)
	Stripes	1	4	(12.3)	26	(86.6)	2.65	(P<.01)
		2	1	(03.3)	29	(96.6)	3.47	(P<.01)
		3	3	(10.0)	27	(90.0)	2.84	(P<.01)
3	Squares	1	20	(66.6)	10	(33.3)	1.61	(P<.05)
		2	21	(70.0)	9	(30.0)	1.98	(P<.05)
		3	24	(80.0)	6	(20.0)	2.48	(P<.01)
	Stripes	1	7	(23.3)	23	(76.6)	2.33	(P<.01)
		2	9	(30.0)	21	(70.0)	2.09	(P<.01)
		3	5	(16.6)	25	(83.3)	2.37	(P<.01)

ed in Sri Lanka. Adults of *K. pulchra* are generally fossorial in habit, and feed extensively at the surface on hymenopterous insects found in or near decaying vegetation (Porter 1972; Smith 1935).

The adaptive significance of learning a preference for a particular substrate pattern is of supreme importance to the survival of these tadpoles. The adult females normally deposit the eggs in a favourable environment thereby ensuring that the hatchling tadpoles will encounter physical cues from the spatial patterning of this habitat, learn to establish a preference for them, and maintain themselves in this habitat until their development is completed. Undoubtedly, the optimal habitat of a species is one which confers a certain degree of camouflage for the animal thereby making it more difficult to detect by its potential predators. Therefore, the survival capacity of the species is greatly increased by the ability to select and remain in the optimal environment. For example, tadpoles that were hatched in an aquatic environment characterized by slender, submergent branches, stems, grasses and algae which are basically linear objects that would project linear shadows on sandy substrates, would have a selective advantage if they were able to rapidly establish a preference for that substrate pattern and thus maintain themselves in a more favourable, cryptic environment. Furthermore, in rapidly flowing streams where tadpoles might be carried by currents, the ability to respond vigorously when confronted by an unfamilar substrate pattern would facilitate the animal in relocating its position to the more favourable habitat. The results of this experiment confirm this hypothesis. When *K. pulchra* tadpoles entered the area of the test chamber characterized by an unfamiliar substrate pattern they became extremely agitated and quickly swam back to the area provided with the pattern on which they had been reared. More frequently, the animals would stop at the boundary between the two substrate patterns and refuse to enter the unfamiliar area.

It is evident from the previous discussion that tadpoles of *K. pulchra* have the capacity to learn rapidly to respond in a positive manner to the substrate pattern on which they are reared, thereby establishing a habitat preference based on early experience. This suggests that the preference response for a particular habitat is not an instinctual and rigid behavioural act but rather a flexible response capable of a high degree of modification. Perhaps the potential to learn to respond selectively to a particular spatial patterning of the environment is innate, but the actual preference established is a function of the substrate pattern that the tadpoles first encounter upon hatching from the egg. This is the first demonstration of the effects of early experience on subsequent habitat selection by microhylid tadpoles, and is in general agreement with some of the findings reported for larval ranids (Heatwole 1962; Sexton *et al.* 1964; Wiens 1970, 1972) and salamanders (McKenzie & Storm 1970; Schneider 1968). In addition, once the preference for a particular habitat has been established, it is retained even over a period of isolation from the preferred substrate. Thus, the role of learning in the evolutionary success of anurans in general, may not be as diminutive a one as suggested by some previous investigators (Nobel 1931; Thorpe 1963).

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Comparative studies on the functional morphology of two gekkonid lizards[1]

Uwe Hiller[2]

(*With two plates*)

Summary

The fine morphology of adhesive bristles in the gekkonids *Tarentola mauritanica* and *Hemidactylus frenatus* was studied by means of scanning electron microscopy (SEM). The adhesive apparatus is similar in both species, and so is their adhesion ability. Former theories regarding gekkonid "strolling on the ceiling" (e.g. insertion of claws, use of suckers, electrostatic forces) are dealt with and are disproved. A single seta of the foot pads consists of a shaft, the surface of which shows longitudinal structures terminally ramifying into first, second or third branchings. These branchings form terminal layers, sometimes with deepenings on the end of each ultimate branch, where adhesion proper occurs.

Adhesion is a physical process relying on the surface tension of the substratum and can be precisely measured by means of the contact angle between distilled water and the substratum. Various materials possess different surface tensions which can even be altered, e.g. by coronary discharge. Increasing surface tensions offer increasing clinging abilities of the geckos.

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Introduction

After the functional morphology of adhesive toes has been elucidated in the Mediterranean gekkonid lizard *Tarentola mauritanica* (Hiller 1968) it is now possible to extend these findings to other gekkonids. The present paper offers an explanation of the adhesive abilities of *Hemidactylus frenatus,* in comparison with *Tarentola mauritanica.* In both lizards body size, toe morphology and adhesive function are similar.

The gecko's ability of walking on vertical surfaces and even on ceilings has been known since a long time. Various authors have speculated on it, and several theories have been advanced. Thus, Cartier (1872) disproved a secretory adhesion (as in tree frogs) because of the lack of digital glands. Tornier (1889) favoured the theory of suction, and Haase (1900) and Schmidt (1904) thought that electrical forces would be responsible for adhesion. Mahendra (1941) arrived at the conclusion that geckos would use their digital setae as claws inserting them into the substratum. The first experimental studies of the problem were done by Hora (1923), who offered substrata of various surface structures correlating them to climbing ability. Dellit (1949) did away with the theory of suction by reducing air pressure down to 0.5 mm Hg,

and yet fresh killed geckos would still cling to the surface structures in the same manner as before. In addition, Dellit could also disprove Schmidt's (1904) theory of electrostatic adhesion by employing X-rays on a gecko clinging to a vertical metal surface. Yet, clinging ability was not reduced. Then, Dellit tried to clean glass surfaces with petrol, and promptly the geckos fell off these substrata. Hence, Dellit concluded that climbing geckos would grip "into" the minute rugosities of the surface. His microscopic study of the adhesive bristles led him to the above mentioned conclusion. However, light microscopy could only partly reveal the fine structure of the setae. His "cleaning" of the glass plates with petrol left a thin film of long-chained carbohydrates, and thus his conclusions were not too well founded. Haase's (1900) adhesion theory was not disproved either.

Obviously, the problem could only be solved by an improved observation technique, functionally and microscopically. Using electron microscopical methods, Altevogt (1954) could show that there are very many more setal ramifications beyond those known to light microscopists. Later, Ruibal & Ernst (1965) continued such studies by transmission electron microscope and depicted the terminal branchings of the digital bristles.

Materials and scanning electron microscopical (SEM) methods

Toes of *Tarentola mauritanica* and *Hemidactylus frenatus*,[3] the Indian house gecko were studied by using the "Stereoscan" Mk 1 and Leitz-AMR 1000.[4] Both these instruments yield images of the surface structures with very high depth of focus. The objects to be studied are glued to aluminium stages by liquid contact silver dispersion. Then they are coated with gold and carbon in alternating repetition.[5] The study proper is done under 20 kV accelerating voltage.

Results

Morphology of adhesive setae

a) **Tarentola mauritanica**

The survey (fig. 1) shows that the adhesive pads cover each toe totally in an imbricate manner. The distal parts of the setae are curved towards a proximal direction. Proximally, their diameter is about 2.5 μm. Their distal ramifications end in plate-like structures of 0.5 μm with a slight central deepening (fig. 2). The surfaces of these minute ramifications are normally arranged in one level at right angles to the longitudinal axis of the seta. The setae originate in fours from a papilla of the basal fibrous layer (Hiller 1972). The distal surfaces, the site of adhesion, of each four setae are also arranged in one level. This is an important fact to make adhesion at all possible.

The distal ramifications can be traced down along the shaft of each seta right to its base. Hence, column-like cannelures can be seen (fig. 3). They are proof of their ontogenetic development as epidermal structures, which also explains the occasional occurrence of other surface structures along the setal shaft without any relevance to adhesion.

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b) **Hemidactylus frenatus**

A palmar view of *Hemidactylus frenatus* shows a typical arrangement of adhesive pads along the toes (fig. 4). Only the distal pad is not paired, the others being arranged in pairs under an angle of about 70° to the median line. The latter is a deep epidermal groove (fig. 5) with several irregular interruptions, and sometimes this medial groove is even absent. The adhesive bristles are 4.5 μm wide, and their length depends on their position on each pad. On the proximal side of a pad they are 50 μm long (fig. 6), and their length increases by about 50 per cent in a distal position (fig. 7). The setae originate in twos to fours as in *Tarentola*. Sometimes, even a single seta sprouts from one papilla. These papillae also give rise to minute and simple setae of only 2 μm length (fig. 8).

Along the shaft of the adhesive setae one can sometimes trace the ramification, so fully developed at the distal portion. Ramification proper begins about 10-15 μm from the distal surface, and sometimes even 5 μm will do. Besides this primary ramification there are secondary branchings yielding even more adhesive surfaces. The length of these secondary ramifications ranges from 2-5 μm (fig. 9). The diameter of these final branches is 0.2 μm. All setae are again curved proximally. There is hardly a broadening of the terminal surfaces in this species.

Comparison of adhesive structures in *Tarentola* and *Hemidactylus*

The gross morphology in *Tarentola* reveals adhesive pads without interruption across the whole toe. All setae are uniformly curved proximally. In *Hemidactylus,* however, the pads are separated by a medial groove, and consequently there is the 70° position referred to above. While there are almost no differences in the structure of the setal shaft in both species, the terminal ramifications are quite different. In *Tarentola,* there are three levels of branchings, in *Hemidactylus* but two. It is highly interesting and certainly very important for the process of clinging that the width of the terminal bristles is 0.2 μm in both lizards. This finding holds also for the New World Iguanids *Anolis carolinensis* and *Anolis roquet extremus* (Hiller 1968). The terminal curvature of setal ramification is equal in both, *Tarentola mauritanica* and *Hemidactylus frenatus.*

Judging from the fine morphology of bristles in *Tarentola* and *Hemidactylus* one may rightly infer that the formation of adhesive structures (Hiller 1970, 1972) is similar if not equal. According to these findings, the setal ramifications originate first by a growth process of keratine bundles from the Oberhäutchen—cell (Oz) into cells of the so called clear layer (Hs). Hence, a matrix of adhesive bristles is formed, and subsequently Hs- and Oz-layer separate from each other giving rise to the adhesive apparatus proper. In the following shedding, the Hs-layer is removed, and the newly formed adhesive bristles are ready for immediate function.

Functioning of adhesive bristles

Judging from the almost identical morphology of adhesive setae in both gekkonids there can be no doubt about the functional principle (Hiller 1968), all the more as *Hemidactylus* is almost as good a climber as *Tarentola.* Though this—physical—principle has been fully elucidated (Hiller 1968), the old theories of suction etc. are still relied on in several scientific and popular papers on this astonishing gekkonid ability (for instance

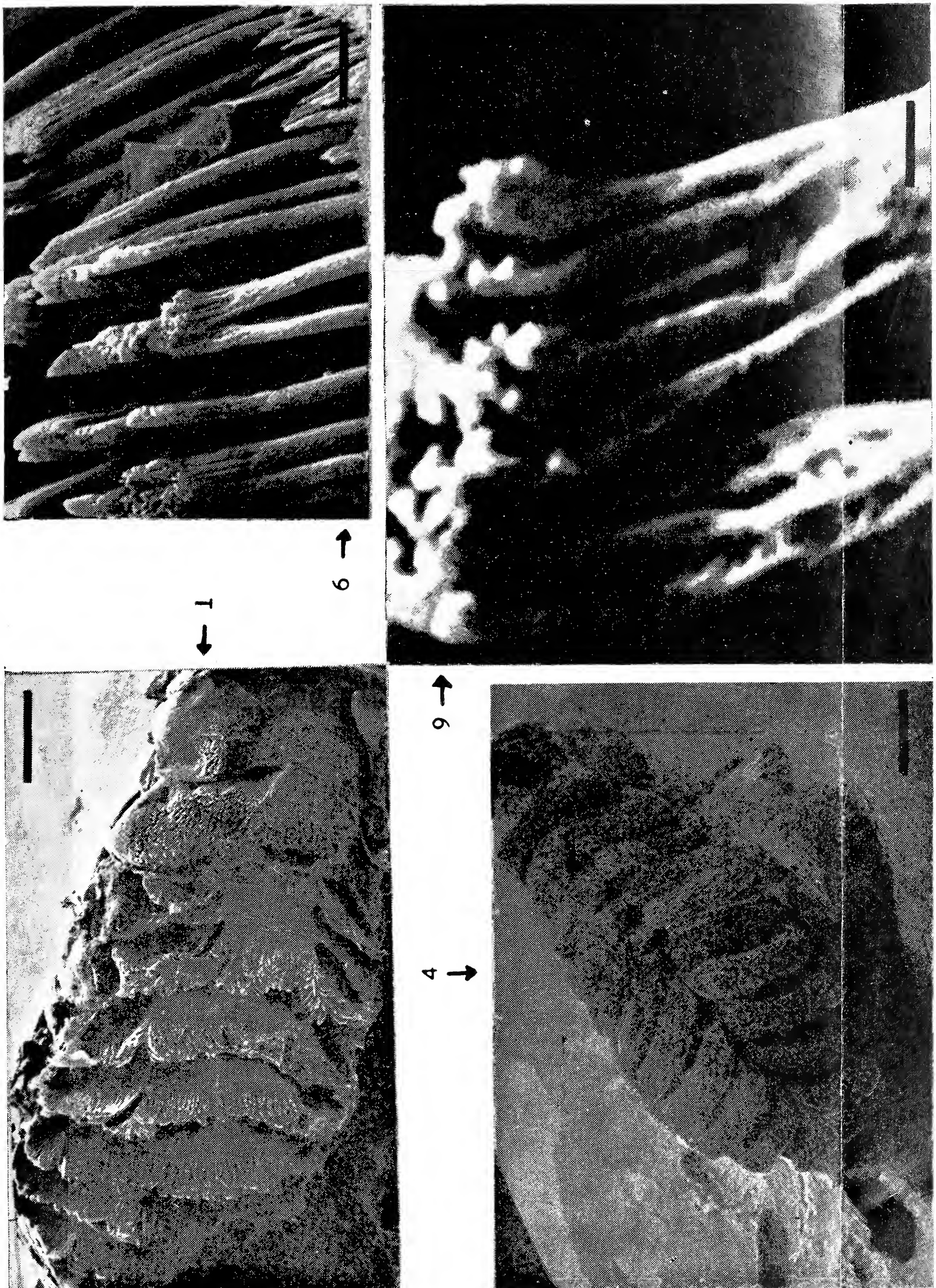

Fig. 1. *Tarentola mauritanica*, toe showing the adhesive pads. Scale 400 μm. Fig. 4. *Hemidactylus frenatus*, palmar view of toe. Note the typical arrangement of adhesive pads. Scale 400 μm. Fig. 6. *Hemidactylus frenatus*, proximal side of a pad with 50 μm long setae. Scale 10 μm. Fig. 9. *Hemidactylus frenatus*, distal ends of a seta, showing the first and second grade ramifications. Scale 1 μm.

PLATE II

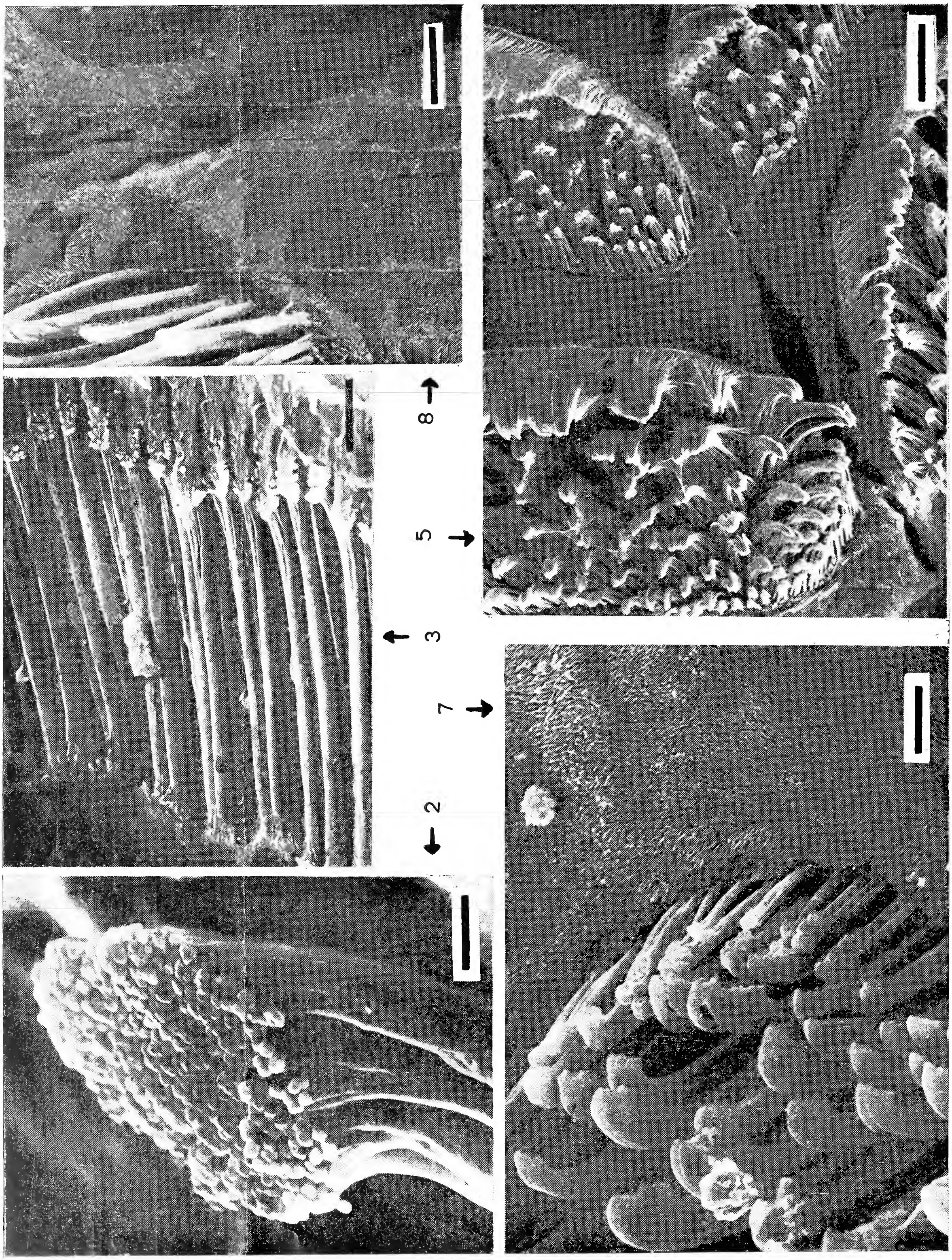

Fig. 2. *Tarentola mauritanica*, distal ramification of a seta. Scale 1 μm. Fig. 3. *Tarentola mauritanica*, adhesive seta showing column-like cannelures along the shaft. Scale 40 μm. Fig. 5. *Hemidactylus frenatus*, median epidermal groove between the adhesive pads. Scale 15 μm. Fig. 7. *Hemidactylus frenatus*, the length of the adhesive bristles in a distal position (left) increases by about 50 per cent. Scale 20 μm. Fig. 8. *Hemidactylus frenatus*, numerous minute and simple setae of only 2 μm length cover the region between the footpads. Scale 20 μm.

Gennaro 1969; Gruber 1971). Using the claws, well developed in some gekkonids, does indeed sometimes play a minor role. On the other hand, on superbly smoothened glass surfaces (by surface melting) the adhesive pads cling so well that sometimes single bristles are torn off the toe.

The physical mechanism of adhesive clinging in geckos is relatively easy to demonstrate by having the animals walk on substrata of high and low surface energy. Surface energy and its role in adhesion has only lately become understood. The surface energy of a material depends on molecular polarity (Driedger *et al.* 1965; Neumann 1967; Sell & Neumann 1966; Baumann 1967). This polarity is especially weak in polytetrafluorethylene (Hostaflon ®, Teflon ®). In newly moulted geckos the bristles' adhesive quality is best developed and loses this ability gradually until the next moulting (Hiller 1968). Even immediately after such a moult, geckos will slip on polytetrafluorethylene and will fall off. Glass, however, shows high molecular polarity, and it is glass, which has made gekkonid clinging so widely known. Surface energy can be quantified, and hence the adhesive mechanism of the various gekkonid species can be precisely compared to each other (Hiller 1969).

In polyethylene sheets, surface energy can be adjusted to a desired level by treating the sheets with (coronary) discharges of high voltage low frequency currents. Depending on the kind of treatment one can produce sheets with surface energies of a wide range which can be measured by the "Union Carbide Testing Method" (Becker 1967-68). In addition, the surface energy of these sheets can be precisely measured by using the contact angle method (c.f. Baumann 1967; Hiller 1968). Adhering power is defined as the force acting in caudal direction, at which, on a horizontal surface, the animal begins to lose its clinging ability and slips off. This force can easily be measured by a spring scale. In table 1 the adhering power (g) is tabulated as a function of surface tension. It is evident from these data that increasing surface energy means increasing adhesive ability.

TABLE 1

ADHERING POWER (G) AS A FUNCTION OF SURFACE TENSION

Sheet	Surface energy (dyn/cm)	Contact angle (°)	Average adhering power (g)
1	32	92.7	85.8
2	36	77.4	133.4
3	36	79.4	137.3
4	36	80.6	141.8
5	48	66.3	142.4
6	50	62.6	149.4

From the physical laws governing surface tension and the physiological processes involved in gekkonid adhesion one must conclude that the above findings are generally applicable to all reptiles capable of "strolling on the ceiling" (Audy 1953) regardless of minor differences in the fine morphology in the setal structure.

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Metamorphic changes in the haemocyte picture of the citrus butterfly, *Papilio demoleus* (L.) (Lepidoptera, Papilionidae)[1]

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Introduction

The haemolymph of insects can undergo quantitative changes to an extent virtually unknown for other tissues. In recent years increased attention has been paid to qualitative and quantitative studies of haemolymph in view of the fact that the internal environment in insects is regulated in its medium. Suggestions have been made for several haematological analyses of insect blood and their applications by Jones (1962) and Wittig (1963). The study presented here is an attempt to characterise the qualitative and quantitative aspects of blood picture of the citrus caterpillar, *Papilio demoleus*. Total haemocyte counts, differential haemocyte counts and blood volume determination have been made in the larval and early pupal stages to study the changes associated with metamorphosis.

Materials and Methods

The citrus caterpillars that are about to moult into third instar which can be recognised by the change in colour from brown to yellowish green were used in the study. Care was taken to keep the groups of test material homogenous by way of selecting 10-12 days old larvae based on colour changes and 1-2 days old pupae. For the differential haemocyte counts the caterpillar was heat-fixed at 52-56°C for a minute or two, and by puncturing the first abdominal proleg, a drop of blood was collected on a clean, grease-free slide. The blood smear preparation was stained with Giemsa stain and the various types of haemocytes were classified according to the recent classification given by Jones (1962) and Patton (1963).

For the total haemocyte counts, the haemolymph was collected in a Thoma White blood cell pipette to the 0.1 mark, diluted with 1.5 per cent acetified saline solution to prevent clotting, and made up to 11 mark. The blood cell counts were made by using double ruled Neubauer Haemocytometer. The number of haemocytes per mm^3 of blood was calculated by counting the cells of five 1 mm square areas in each of the two chambers by using the formula given by Jones (1962):

$$\frac{\text{Haemocytes in five } mm^2 \times \text{Dilution factor} \times \text{Depth factor}}{\text{Number of squares counted}}$$

The procedure for dye dilution technique

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described by Lee (1961) was adopted using Congo red for the blood volume determination. Fifty ml of Congo red equivalent to 0.125 mg of the dye was injected into the haemocoele through the first abdominal proleg and inserted upto the thorax region. After five minutes, 100 ml of blood was drawn and made up to 7 ml with stock solution of sodium chloride and its optical density determined using Systronics colorimeter at 480 mμ with a blue filter. In the case of 1-2 days old pupae, owing to the small quantity of the haemolymph, only 50 ml of blood was drawn, made up to 7 ml and optical density determined.

From the optical density values of the sample, the amount of the dye in the blood sample was determined by referring to a standard graph. From the amount of dye injected and the amount of dye in the blood sample, the blood volume was determined by the formula given by Lee (1961):

$V = (dg_1/g_2)—a$, where 'V' is the volume of blood, 'g_1' is the weight of the dye injected, 'g_2' is the weight of the dye in the sample, 'd' is the volume of the sample and 'a' is the volume of saline injected with the dye.

To this value is added 100 ml as 100 ml of blood was drawn from the test insect in the case of larvae and 50 ml in the case of pupae to serve as blanks. In the estimation of the blood volume, the wet weight of the animal is important, as the water imbibed by the insect constitutes to the dilution of the blood and a certain proportion to hydration of tissues. The wet weight was determined after removing adhering water from the insect which was wiped well with folds of filter paper. The blood volume was expressed as percentage of wet weight of the animal in mm^3.

Results and discussion

The blood of the larva and pupa of *Papilio demoleus* was pale yellowish green in colour and watery in consistency. It took about 35 minutes to clot when extracted from the heat fixed sample. The clotting of the blood was accompanied by a change in colour to dark green and ultimately black.

1. *Differential haemocyte counts*

There is much confusion in insect haematology since few authors have agreed on a common terminology. A critical discussion of the problem of blood cell classification was recently put forth by Jones (1962), and in the present paper the terminology suggested by him and Patton (1963) has been adopted. The cell types namely prohaemocytes or proleucocytes, plasmatocytes, spindle-shaped cells and vermiform cells could be distinguished in the haemolymph of *P. demoleus* larvae. The plasmatocytes constitute the major portion of the haemocytes counted, followed by prohaemocytes, spindle-shaped cells and vermiform cells.

The prohaemocyte has a large nucleus and very little cytoplasm whereas the plasmatocytes have well defined cytoplasm and small nucleus. The cytoplasm of this type of cell may be relatively clear, or in certain cells granules and vacuoles may be found. The spindle-shaped cells are also with small nucleus and well defined cytoplasm with vacuoles. In the case of vermiform type of cells, both the ends of the cell are twisted in a thread-like manner and have small nucleus with large cytoplasm. The spindle-shaped cells and vermiform type of cells now observed in *P. demoleus* larvae may be nothing but the plasmatocytes which at times may send out pseudopodia or get rounded up, or twisted at both the ends as suggested by Jones (1962) and Patton (1963). When viewed edgewise the plasmatocytes may become spindle-shaped.

2. *Total haemocyte counts*

It is seen from Table 1 that the total haem-

ocyte counts (THC) of heat-fixed larvae ranged from 17500 to 22750 cells/mm^3 with a mean of 21541 cells. In the case of pupa, the blood cells varied from 2250 to 3250 cells/mm^3 with a mean of 2812 cells. It is evident that there has been a 7.7 fold decrease in the number of haemocytes from the actively feeding larval stage to the inactive pupal stage.

That the total and differential haemocyte counts are diminished in the pupal stage has also been reported in *Anagasta kuhniella* (Zeller) (Arnold 1952), *Bombyx mori* (L.) (Nittono 1960), *Pectinophora gossypiella* (Saunders) (Clarke & Chandbourne 1960), *Prodenia eridania* (Cramer) (Yeager 1945; Rosenberger & Jones 1960), *Galleria mellonella* L. (Jones 1967a) and *Sarcophaga bullata* P. (Jones 1967b).

3. *Haemolymph volume*

The haemolymph volume expressed as percentage of the body weight of the larvae ranged from 29.48 to 37.20 with an average of 32.94 (Table 1). In the case of pupae the volume ranged from 15.90 to 19.87 per cent with a mean of 17.53. The volume has been decreased by 46.8 per cent in the pupa. This reduction is in accordance with the observations made by Lee (1961) in the case of locust *Schistocera gregaria* in which the volume of 22.0 per cent in nymph was reduced to 13.95 per cent in the newly formed adult. Similarly Jones (1967a) found that the haemolymph volume declined from 34 per cent in precocoon spinning larvae to 16.4 per cent in the newly formed pupa in *Galleria mellonella*. These observations indicate that fluctuations in blood volume are related to the stage of development of an insect.

The results presented above on THC and haemolymph volume of both larvae and pupae may be combined to indicate the changes in the haemocyte population within the whole insect. When the THC was multiplied with haemolymph volume the calculated haemocyte population could be arrived at. The estimated mean number of haemocytes in the whole larva was found to be 7,09,562 as against only 49,226 in the pupa (Table 1).

TABLE 1

HAEMOCYTE COUNTS, BLOOD VOLUME AND EXPECTED POPULATION OF HAEMOCYTES IN THE LARVAE AND PUPAE OF *Papilio demoleus* L.

Particulars	Larva	Pupa	% decrease in pupa	Levels of significance (%)	S.E.	CD.
1. Total Haemocyte counts (THC)	21541.30	2812.5	86.9	1	1381.0	4289.3
2. Blood volume (% on wet weight basis)	32.94	17.53	46.8	1	2.1	6.5
3. Expected Haemocytes population (THC x Blood volume)	7,09,562	49,226	93.0	1	19055	50184

Acknowledgement

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Plants of Corbett National Park, Uttar Pradesh[1]

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(*With a map*)

A sketch of the vegetation and its constituent elements, in the Corbett National Park, with local names for several of the plants as also a habit-wise list of 232 species is presented.

Currently, an awareness of our rapidly changing environment, and the consequent need for conservation of the quickly altering and sometimes dwindling or even disappearing wild life, including plants and animals, has underlined the need, for an adequate knowledge of our wild life. In different parts of the country National Parks and wild life sanctuaries have been established. In view of the more appealing nature of the wild animal life and the publicity given to some, like the lion, the rhino and the tiger, the plant cover in which these live and the close interaction of vegetation with animal life, tends to remain unemphasised. However, recently this aspect is being attended to and either preliminary or full accounts of the flora of some of our sanctuaries and National Parks have been published (Santapau & Randeria 1955, Maheshwari 1963, Naithani 1966). The Botanical Survey of India has taken up detailed and elaborate study of the vegetation of these interesting areas, in different parts of the country. Thus Botanical Survey of India (Northern Circle) has been concerned with the vegetation of Corbett National Park, which is within its area. This account is based upon studies and collections made at intervals during November, 1970 to May, 1971 at different points in the park (Map).

Corbett National Park, earlier twice differently named, first as Hailey National Park, in 1935, and later as Ramganga National Park, is situated in the foot hills of the Western Himalayas, along Delhi-Ranikhet National Highway between 29° 13′ 30″ and 29° 35′ 15″ N and 78° 46′ and 79° 33′ E. Originally comprising of an area of about 324 sq km it now extends to 525 sq km. The park partly consists of the forest reserves of Ramnagar and Kalagarh division of Uttar Pradesh. The part in Kalagarh division includes the drainage area of the Ramganga river (Map).

The natural forest of the park is confined to the Bhabar tract of Siwalik formation at altitudes of 700-1500 m with varied topography of many temporary marshy depressions, ravines and plateau land (Patli Dun). The river Ramganga flows through the plateau in westward direction before it takes a southward turn at Boxar. An appreciable portion of the present park area along the Ramganga river will be submerged in the near future on com-

[1]Accepted August 1973.

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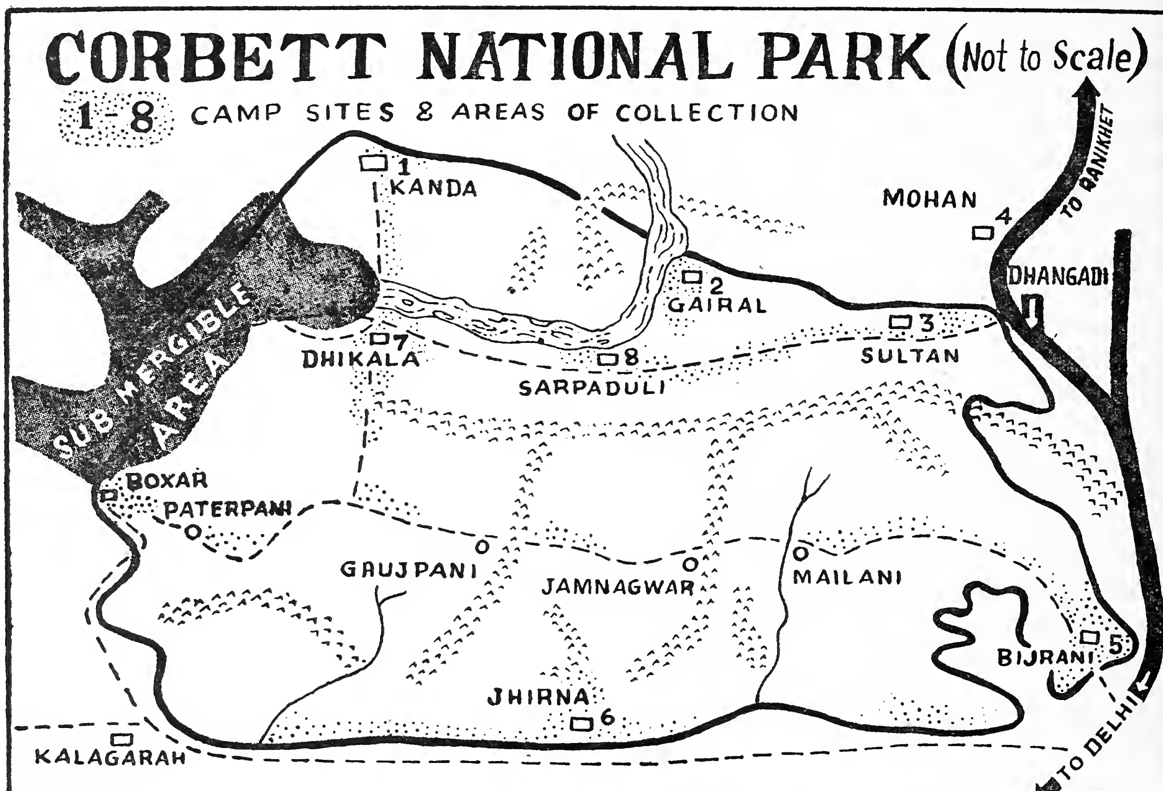
pletion of the "Ramganga Multipurpose Hydel Project" at Kalagarh (Uttar Pradesh). This project necessitates all the more, the urgent conservation of vegetation in suitable areas to avoid silting and protect the vicinity of the dam from soil erosion, as it has begun to become evident in the case of some other multipurpose hydel projects.

Geologically, like other submontane tracts of the Western Himalayas the park belongs to Siwalik formation which is composed of conglomerates, sand rocks, sand stones and boulders. The soil is alluvial, the river beds are composed of water borne debris of the granite core of the Himalaya, small rounded pebbles, scattered conglomerates, loose river gravel and sand.

The climate of the park area can be broadly distinguished as being cold from December-February with chilly and often frosty nights, at times with sufficient rains during this period, warm with sultry and high temperature from May-June, at times thunder showers with hail-stones not being unusual. Wet, warm and humid July-September with plenty of monsoon rains. During October-November with south-west monsoon retreating autumn prevails with clear days and moderate temperature. Spring is ushered in March-April, the period being quite pleasant with moderate warmth,



Map of Corbett National Park.

and fast growing vegetation all round.

The vegetation is a mixed one of deciduous tropical and subtropical species. Mention may be made of botanically interesting pockets in the park such as Dhulwa east, Dhikala, Dhangadi nallah, Panod nallah, Pater nallah (Paterpani block), Kanda, Domunda block, Riparian tract of Ramganga and the section between Bijrani-Mailani.

The dominant tree species in the park is Sal (*Shorea robusta*), with its characteristic straight bole forming pure stands. After crossing Gajar sot near the sultan Forest Rest House there is a particularly dense, pure population of these lofty trees. A frequent associate of sal is *Adina cordifolia* with its buttressed base, hard reddish brown wood and heart shaped leaves. *Holarrhena antidysenterica* is a shorter tree with rough, brown bark, white flowers and slender follicles, also occurs scattered amidst the Sal. In open scrub land, one can easily spot *Bombax ceiba* the silk cotton tree; a tall deciduous tree with buttressed stem, widespread branches with large upright crimson flowers and woody capsules with closely packed seeds all covered in white silky hairs. A few other easily noticeable trees in the park are *Anogeissus latifolia;* a gregarious tree on hilly tracts with smooth pale yellowish or pinkish brown fluted crooked trunks and the foliage turning purple red at the onset of winter. *Piliostigma malabarica* with rough dark brown or blackish bark and characteristically acidic leaves. *Bauhinia racemosa* with short bole, low spreading crown, deeply fissured bark and sickle shaped pods. *Kydia calycina* with pale brown bark, heart shaped leaves and panicles of white flowers. *Lagerstroemia parviflora* with lax panicles of white flowers and ellipsoid glossy fruits. *Cassia fistula*—the Indian Laburnum, with dark grey rough bark, pendent bunches of bright yellow blossoms and slender cylindrical long fruits. *Semicarpus anacardium* with obovate-oblong leaves, turning to yellow before falling and black fruits hanging from bright orange fleshy receptacles. *Emblica officinalis* with minute greenish flowers in axillary fascicles and pale yellow, waxy, sour fruits, *Zizyphus mauritiana* with dense spreading crown, blackish to grey or brown bark, yellow to red, globose or ovoid stony fruits.

Some other miscellaneous deciduous species are *Holoptelea integrifolia* or Indian Elm—A large tree, bark smooth silvery grey with small green flowers and membraneous circular winged fruits. *Careya arborea* with brown bark, large sweet scented flowers and numerous conspicuous stamens. *Madhuca indica* with dark brown bark, fascicles of fragrant flowers and the sweet fleshy corolla which is edible raw, or used in sweet preparations. Mention may be made of *Erythrina* sp. and *Butea* sp. with their characteristic butterfly shaped scarlet and bright red orange tinged corollas, respectively.

Among the evergreen trees along the dry nallahs and on exposed habitats occur *Wendlandia heynei* with terminal pyramidal panicles of small white fragrant flowers. On other places a noticeable tree species is *Mallotus philippensis* with its leaves having the characteristic red glands and the fruits coated with a scarlet red resinous powder. *Syzygium cumini* or Black plum with pale brown bark, small fragrant flowers and the familiar dark violet fleshy edible fruits. The only indigenous conifer at Ghilmodya sot (Forest compartment No. 9/10) in the park boundary is *Pinus roxburghii* with the dark green needles in threes. Association of *Dalbergia sissoo-Acacia catechu,* along Ramganga river bordering Savannah at Dhikala is an interesting feature in the landscape of the park where a large area is covered with a dense growth of *Themeda arundinacea* a tall wavy

grass, bordered with *Thysanolena maxima* and *Vetiveria zizanioides*. Annually after the burning of the dense dry grass of the savannah of Dhikala (Dhikala chaur) there spring up amidst the new culms many other herbaceous element. This temporary herbaceous growth constitutes the food of the herbivorous hog-deer (Para) and spotted deer (Chital). Some of the easily noticeable herbaceous elements on Dhikala chaur are *Evolvulus alsinoides* with wiry branches and beautiful blue flowers. Roughly pubescent, slender, *Vicoa indica* with its yellow floral heads and *Lactuca* sp. with milky latex. *Trichodesma indicum* with rough leaves and funnel shaped corolla crowned with its cone of anthers. Other species that may be mentioned are *Ajuga, Polygala, Desmodium, Crotalaria, Oldenlandia,* rush like Cyperaceae and terrestrial orchids such as grass like *Zeuxine* and tuberous *Eulophia* species with flowers in varying shades of pink-blue. An interesting stemless undershrub in Dhikala chaur with its close rosette of 2 or 3 pairs of leaves resting on the ground is the dwarf *Pygmaeopremna herbacea.*

Apart from the savannah land of Dhikala, in quite a number of other spots also members of the Poaceae are widespread. Amongst these may be mentioned *Eulaliopsis binata, Apluda mutica, Oplismenus compositus* and *Eragrostis uniloides*. Of these *Eulaliopsis binata*—the baib grass is of considerable commercial value being used in the paper industry.

At other places in the park amongst common shrubs mention may be made of *Clerodendrum viscosum* with quadrangular channelled branches, large opposite leaves, scented white flowers and red fruits. This is a very close associate of Sal and densely gregarious. *Colebrookea oppositifolia* with densely silky tomentose quadrangular twigs. *Pogostemon benghalense* with herbaceous purple-tinged, smooth, sub-quadrangular twigs and strong aromatic flowers in dense spikes, *Adhatoda vasica,* with two lipped white flowers and foetid smelling leaves. *Artemisia nilagirica,* with aromatic pinnatisect leaves. *Spermadictyon suaveolens* with blue flowers and foetid smelling young leaves. *Murraya paniculata,* with numerous fragrant white flowers. *Murraya koenigii,* with its aromatic leaves (used in flavouring curries), *Rubus ellipticus,* with prickly stem and branches, white flowers and golden yellow succulent fruits, favourite of the birds in the area. *Zizyphus xylopyros,* with its spreading crown, rusty tomentose prickly twigs. *Zizyphus oenoplia,* a straggling shrub with slender, brown tomentose twigs. *Glycosmis arborea,* with its orange smelling glossy leaves and white flowers, forms dense gregarious groups.

Still other shrubs of interest in the area are *Helicteres isora,* easily noticed due to its twisted fruits. *Moghania strobilifera* a loosely branching shrub with foliaceous bracts concealing the small flowers and later the little pods. *Sida cordifolia* a diffuse shrub with pale yellow flowers. *Sida orientalis,* with stellately hairy branches and rhomboid 3-nerved leaves. *Tephrosia candida,* with grooved branches, white and at times red-tinged flowers. *Carissa spinarum* an evergreen dense thorny shrub with sweet scented pinkish-white flowers. *Woodfordia fruticosa* a large shrub with long branches and numerous clustered tubular red flowers.

Among fleshy climbers occasionally *Pothos* can be seen scrambling over the tall trunks of Sal trees. The lianoid climbers of common occurrence in the park area are *Milletia auriculata,* with odd pinnate leaves and woody brown velvety pods; *Cryptolepis buchanani* with dark purplish-brown or blackish bark, terete whitish branches, opposite leaves and fruits of 2 divari-

cating follicles; *Aspidopterys nutans,* with opposite leaves, scented flowers and winged fruits; *Vallaris solanacea,* with fragrant white flowers tinged with green and blaze exuding milky juice. Forming a striking scene with its dense canopy of profuse flowers covering small to tall trees, is another fairly common climber, *Porana paniculata.* Still another common climber is *Phanera vahlii,* cream yellow flowered and with rusty, flat pods enclosing glossy dark brown seeds.

Parasitic plants, particularly the stem parasites, are easily noticeable due to their foliage, quite different from that of their host trees. These are *Dendrophthoe falcata,* with grey smooth bark, thick and fleshy leaves, upon *Shorea robusta. Scurrula pulverulenta,* with young leaves and shoots having white flocculent fugaceous tomentum and thick opposite leaves, on *Boehmeria rugulosa* and *Shorea robusta. Scurrula cordifolia*, with dark brown smooth bark, leaves covered with buff coloured scurfy tomentum on *Ougeinia ougeinensis. Cuscuta reflexa* the holo-parasite, leafless and long stranded, covers many shrubs and low trees.

The epiphytic growth is scarce and consists of a few orchid species like *Vanda* with flat keeled leaves and *Bulbophyllum* with leaves on pseudobulbs. These too are seen only in the environs of Bijrani and Sultan respectively.

There are numerous prostrate, slender herbs forming the ground cover. Of these the most noticeable, particularly in moist shady habitats is *Drymaria diandra* a spreading slender annual with stem-clasping cordate leaves and small white flowers. Other scattered fairly common herbs are *Justicia procumbens,* with quadrangular branches and flowers in dense axillary or terminal spikes. Procumbent *Borreria articularis* with opposite leaves and many tiny white flowers in compact globose axillary heads. *Boerhaavia diffusa,* with deep stout roots and very small umbellate red flowers atop diffuse branches. Erect, *Cynoglossum lanceolatum* with white bluish-tinged flowers and fruiting nutlets with barbed bristles. Small hairy annual, *Gonotheca ovalifolia,* generally with four unequal leaves in a whorl. Procumbent *Indigofera linifolia,* with bright red flowers and small pods, Hoary tomentose *Leucas mollissima* with quadrangular stems and white flowers. Erect much-branched *Bupleurum hamiltonii,* with umbellate, yellow coloured flowers. Prickly bright green *Solanum surattense* with bluish flowers and yellow berries streaked green. Small delicate *Oxalis* sp. with 3-foliolate leaves. There are several members of the large family Asteraceae, easily recognised when in bloom by their characteristic heads. Of these mention may be made of *Vernonia cinerea* with beautiful pink-lilac heads. Radiating heads of *Erigeron canadensis* with flat heads, the heads with yellow tiny disc florets, encircled by white ligulate florets. Dichotomously branched deep rooted *Elephantopus scaber* with radical leaves and violet-purple, tubular flowers. *Bidens biternata* with white ray florets and sticky achenes. *Tridax procumbens,* with pinnatisect leaves and the head atop a long weak scape. A striking constitutent of the undergrowth below *Dalbergia sissoo* at Dhikala along the Ramganga river is *Leonotis nepetaefolia* singularly straight, with its stiff quadrangular stem and interspersed large globose green verticillasters and projecting bright orange to red bilipped flowers.

Another noticeable plant is the scrambling cypress vine—*Ipomoea quamoclit* with its finely divided leaves and scarlet flowers.

Purely aquatic vegetation does not exist in the park, but there are many herbaceous plants characteristic of moist, marshy or water-logged areas. Of these mention may be made of

Ammania sp. *Oenothera* sp., *Veronica* sp., *Hypericum* sp. and *Polygonum* sp. In temporary little pools occur small colonies of *Potamogeton,* and here and there can be noted the characteristic rush-like clumps of Cyperaceae members. In open, moist areas *Ranunculus* sp. also occurs, easily noted when in bloom.

Amongst some of the other familiar plants should be mentioned the bamboos. They occur frequently in several blocks of the park. There are practically no palms, excepting for the stemless *Phoenix acaulis* scattered at places along the park boundary and the quite rare palm *Wallichia densiflora* easily recognised by its large leaves, the leaflets dark green above and white beneath.

Mention should also be made of some of the non-flowering plants. In many cool, shady moist areas, often in gregarious patches occur different species of ferns, all of them equally attractive due to their differently dissected leaves and the variously coiled young fronds. *Pteris* sp. *Adiantum* sp. etc. occur along running streams appearing almost like an arranged fernery. The snake-tongued fern *Ophioglossum reticulatum* has been spotted below sal trees, and the horse-tails or scouring rushes—*Equisetum* has been seen in clumps on sand banks along the river or stream margins.

The park with its falling trees, rotting trunks and accumulating debris supports its due share of fleshy and other kinds of fungi and lichens. The liverworts and the mosses too are seen in their usual habitats, on moist trunks. But this study has not particularly touched them.

The Corbett National Park is becoming increasingly popular with tourists, and has already begun to show evidence of the hand of man in altering vegetation. Established weeds that follow closely on the heels of man have begun to settle and spread. This will undoubtedly affect the indigenous vegetation. Amongst these enterprising hardy intruders should be mentioned the ubiquitous *Lantana*. Still others are *Acanthospermum hispidum* and *Xanthium strumarium*. Yet another naturalised element forming gregarious colonies, is the 'Bhang' or *Cannabis sativa.*

The plants collected during this preliminary study have been classified habit-wise and listed with local Hindi vernacular names for some species as gathered from the staff of the forest department. The collection is deposited in the Botanical Survey of India, Northern Circle Herbarium at Dehra Dun (BSD).

LIST OF PLANTS

TREES

Adina cordifolia (Roxb.) Hook. f. ex Brandis 'Haldu'
Aegle marmelos (L.) Corr. 'Bel'
Albizzia odoratissima Benth.
Anogeissus latifolius (Roxb.) Wall. ex Bedd. 'Bakli'
Bauhinia racemosa Lamk.
Bauhinia retusa Roxb.
Boehmeria rugulosa Wedd.
Bridelia squamosa (Lamk.) Gehrm.
Dalbergia sissoo Roxb. ex DC. 'Sisham'
Diospyros exsculpta Buch.-Ham.
Ehretia laevis Roxb.
Emblica officinalis Gaertn. 'Aonla'
Ficus benghalense L. 'Bar'
Grewia glabra Bl.
Kydia calycina Roxb. 'Pula'
Madhuca indica Gmel. 'Mahwa'
Mallotus philippensis (Lamk.) Muell.-Arg. 'Roli'
Piliostigma malabaricum (Roxb.) Benth. 'Khatwa'
Semicarpus anacardium L.f. 'Bhilawa'
Terminalia alata Heyne ex Roth
Trema politoria Planch.
Wendlandia heynei (R. & S.) Sant. & Merch. 'Tirchoniya'
Zizyphus mauritiana Lamk. 'Ber'

SHRUBS

Abutilon indicum (L.) Sweet
Acanthospermum hispidum DC.
Achyranthes aspera L.
Achyranthes bidentata Bl.

Adhatoda vasica Nees
Aerva sanguinolenta (L.) Bl.
Ageratum conyzoides L.
Alysicarpus vaginalis DC.
Ardisia floribunda Wall.
Ardisia solanacea Roxb.
Arachne cordifolia (Decne.) Hurusawa
Artemisia nilagirica (Clarke) Pamp.
Asparagus adscendens Roxb.
Barleria cristata Lindl.
Barleria strigosa Willd.
Boehmeria platyphylla D. Don
Buddleja asiatica Lour.
Callicarpa macrophylla Vahl.
Cannabis sativa L. 'Bhang'
Carissa spinarum L.
Cassia occidentalis L.
Cissampelos pariera L.
Clerodendron viscosum Vent.
Colebrookea oppositifolia Sm.
Crotalaria bialata Schrank
Crotalaria sericea Retz.
Crotalaria tetragona Andr.
Deeringia amaranthoides (Lamk.) Merr.
Desmodium gangeticum DC.
Desmodium heterocarpon (L.) DC.
Desmodium pulchellum (L.) Benth.
Desmodium retusum (D. Don) Sweet
Embelia robusta Roxb.
Glycosmis arborea (Roxb.) Corr.
Helicteres isora L. 'Maror phali'
Holmskioldia sanguinea Retz.
Inula cappa DC.
Inula cuspidata Cl.
Isodon coesta (Spreng.) Kudo
Lantana camara L.
Maesa indica Wall.
Maoutia puya Wedd.
Mimosa himalayana Gamble
Mimosa rubicaulis Lamk.
Moghania strobilifera (L.) St. Hil. & Jacks.
Murraya koenigii (L.) Spreng.
Pavetta tomentosa Roxb. ex Rees
Phoenix humilis Royle
Pogostemon benghalense (Burm. f.) O. Ktze
Pupalia lappacea Jacq.
Rumex hastatus D. Don 'Bhilmora'
Scoparia dulcis L.
Scutellaria repens Buch-Ham. ex D. Don
Sida acuta Burm. f.
Sida cordifolia L.
Sida orientalis Cav.
Sida rhombifolia L.
Solanum erianthum D. Don
Solanum incanum L.
Solanum khasianum Cl.
Spermadictyon suaveolens Roxb.
Tamarix dioica Roxb.
Tephrosia candida DC.
Triumfetta rhomboidea Jacq.
Uraria lagopodioides (L.) Desv. ex DC.
Uraria neglecta Prain
Urena lobata L.
Urtica parviflora Roxb.
Woodfordia fruticosa (L.) Kurz
Xeromphis spinosa (Thunb.) Keay
Zizyphus nummularia (Burm. f.) Wt. & Arn.
Zizyphus oenoplia (L.) Mill.
Zizyphus xylopyros (Retz.) Willd.

HERBS

Acrocephalus indicus (Burm. f.) O. Ktze.
Adenostemma lavenia (L.) O. Ktze.
Adiantum caudatum L.
Adiantum philippense L.
Aleuritopteris grisea (Blauf.) Panigrahi
Amaranthus spinosus L.
Ammania multiflora Roxb.
Anagallis pumilla Swartz
Anaphalis busua (Buch.-Ham.) Hand.-Mazz.
Anisomeles indica (L.) DC.
Apluda mutica L.
Artemisia scoparia Waldst. & Kit.
Asplenium alternans Wall.
Athyrium pectinatum (Wall.) Pr.
Atylosia crassa Prain
Atylosia scrabaeoides Benth.
Bidens biternata (Lour.) Merr. & Scherff
Biophytum reinwardtii Klotzsch
Blainvillea acmella (L.) Philipson
Boerhaavia diffusa L.
Borreria articularis (L.) F.N. Wils.
Borreria pusilla (Wall.) DC.
Brachiaria distachya (L.) Stapf
Bupleurum hamiltonii Balakrishnan
Canscora diffusa R. Br.
Canscora decussata R. & S.
Cassia obtusifolia L.
Cassia tora L.
Cheilanthes farinosa (Forsk.) Fee
Chenopodium album L.
Chenopodium ambrosioides L.

Chrysanthellum americanum (L.) Vatke
Conyza stricta Willd.
Corchorus olitorius L.
Crotalaria albida Heyne ex Roth
Crotalaria calycina Schrank
Cyclosorus aridus (Don) Ching
Cyperus brevifolius (Rottb.) Hassk.
Cyperus globosus All.
Cyperus kyllinga Endl.
Cynoglossum lanceolatum Forsk.
Cythocline purpurea (D. Don) O. Ktze.
Dichanthium annulatum (Forsk.) Stapf
Dicliptera roxburghiana Nees
Dipteracanthus beddomei (Cl.) Santapau
Distemon indicum Wedd.
Dryopteris arida (Don) O. Ktze.
Dryopteris cochleata (Don) C. Chr.
Drymaria diandra Blume
Elephantopus scaber L.
Emila sonchifolia DC.
Eragrostis tenella (L.) P. Beauv. ex Roem. et Schult.
Eragrostis uniloides (Retz.) Nees ex Steud.
Erigeron canadensis L.
Eriophorum comosum Wall. ex Nees
Equisetum debile Roxb.
Euphorbia hirta L.
Euphorbia hypericifolia L.
Evolvulus alsinoides L.
Floscopa scandens Lour.
Gonotheca ovatifolia (Cav.) Sant. & Wagh
Hedyotis verticillata (L.) Lamk.
Indigofera linifolia Retz.
Justicia procumbens L. var. *simplex* (D. Don) Yamazaki
Justicia prostrata Gamble
Knoxia sumaatrensis (Retz.) DC.
Laggera falcata (D. Don) O. Ktze.
Leonotis nepetaefolia R. Br.
Lepidagathis incurva D. Don
Leucas cephalotes (Roth) Spreng.
Leucas lanata Benth.
Leucas molissima Wall.
Limnophila indica (L.) Druce
Lindernia anagallis (Burm. f.) Pennell
Lindernia ciliata (Colsm.) Merr.
Lindernia nummularifolia (Don) Wettst.
Lindenbergia indica (L.) Vatke
Lygodium flexuosum (L.) Sw.
Malvastrum coromandelianum (L.) Garcke
Mazus pumillus (Burm. f.) Steenis
Mukia madraspatana (L.) Roem.
Murdannia nudiflora Roxb.
Murdannia spirata (L.) Brueckn.
Nelsonia canescens (Lamk.) Spreng.
Nepeta graciliflora Bth.
Ophioglossum reticulatum L.
Oplismenus compositus (L.) P. Beauv.
Perilla frutescens (L.) Britt.
Peristrophe bicalyculata (Retz.) Nees
Peristrophe speciosa Nees
Phaseolus aureus Roxb.
Phaseolus trilobus Ait.
Phyllanthus urinaria L.
Phyllanthus virgatus J.G. Forst.
Polygonum barbatum L.
Polygonum glabrum Willd.
Polygonum hydropiper L.
Pouzolzia pentandra Benn.
Pouzolzia zeylanica (L.) Benn.
Pteris biaurita L.
Rhynchoglossum obliquum Blume
Rungia pectinata (L.) Nees
Sida cordata (Burm. f.) Bross.
Siegesbeckia orientalis L.
Solanum nigrum L.
Solanum surattense Burm. f.
Sorghum nitidum (Vahl) Rees
Tectaria macrodonta (Fée) C. Chr.
Tephrosia hamiltonii J.R. Drummond
Themeda arundinacea (Roxb.) Hassk.
Themeda villosa (Poir) A. Camus
Torenia cordifolia Roxb.
Trichodesma indicum (L.) Lehm.
Tridax procumbens L.
Vernonia cinera Less.
Vetiveria zizanioides (L.) Nash
Vicoa indica (L.) DC.
Zornia gibbosa Span

WOODY CLIMBERS

Abrus fruticulosus Wall. ex Wight & Arn.
Acacia pennata (L.) Willd.
Acacia torta (Roxb.) Craib
Caesalpinia bonduc (L.) Roxb.
Clematis gouriana Roxb. ex DC.
Clematis roylei Rehder
Ichnocarpus frutescens (L.) Ait.
Milletia auriculata Baker
Porana paniculata Roxb.
Tetrastigma lanceolarium Planch.

HERBACEOUS CLIMBERS

Ampelocissus divaricata (Wall.) Planch.
Dioscorea anguina Roxb.
Ipomoea hederifolia L.
Ipomoea purpurea Roth
Ipomoea quamoclit L.

PARASITES

Dendrophthoe falcata (L.f.) Ettingh.
Scurrula cordifolia (Wall.) G. Don
Scurrula pulverulenta (Wall.) G. Don

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I express my thanks to wild life Warden, Corbett National Park and his staff for rendering facilities in the exploration work.

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Some birds observed in the monsoon in Central Nepal[1]

M. W. AND B. J. WOODCOCK[2]

(*With a text-figure*)

The following notes were made during a three week trek from Pokhara towards Annapurna at the height of the monsoon in July and August 1973. Our original objective was to get up to around 14,000 feet in the Annapurna "Sanctuary" area to find and study breeding Rosefinches (*Carpodacus* spp.), but this proved somewhat ambitious in view of the time available to us. Also, there was an unfortunate deterioration in the weather when we were within three or four hours of our objective, and we were forced to camp at Hinko cave, at around 10,400 feet in the valley of the Modi Khola, by cold driving rain and high winds, and we could not spare the few days necessary to allow the weather to moderate and still give us time for our return walk.

Despite the conditions, every opportunity was taken to study and identify the birds that came under our notice, and we hope that in recording this list, some comparison may be made with the species encountered at other times of the year when it is easier to operate, and in consequence for periods covered by most other accounts. One or two of the comments concern birds observed in the Gokarna Forest Reserve near Kathmandu.

We would like to record our gratitude to Richard Odell and John Flatt of the Lumle Agricultural Research station for much kindness and assistance, and to Dr. Robert Fleming of Kathmandu for his comments on the list.

Pernis ptilorhynchus—Crested Honey Buzzard

A single bird circled round overhead several times in the Gokarna Reserve, on 8th August. It was flying at tree-top height, and therefore easily identifiable, being in fairly typical plumage, with well barred wings, and two bars close to the base of the tail. Proud (*JBNHS 53*:71) records a Honey Buzzard sp. as common in the valley between November and March, and Biswas (*JBNHS 57*:283) records two females from Hitaura in the *Dun* in July.

Milvus migrans govinda—Pariah Kite

Common at Kathmandu and Pokhara. One at Ghandrung at 2350 m.

Milvus migrans lineatus—Large Indian Kite

Three birds together on hillside above Pokhara at 1130 m.

Accipiter nisus—Sparrow-Hawk

A large immature Sparrow-hawk above Chhumrung at 2350 m was thought to be of this species. It was seen well as it perched on a branch, and the tarsus looked long and thin enough to rule out the Shikra (*A. badius*).

Spizaetus nipalensis—Hodgson's Hawk-Eagle

Two birds of either this species or *S. cirrhatus*, the Changeable Hawk-Eagle, were seen soaring over forest in the Modi Khola valley

[1] Accepted January 1975.

[2] The fives, Elderden Farm, Staplehurst, Tonbridge, Kent, England.

near Chhumrung at about 2400 m. They were dark brown above, rather bleached in places, and showed dark, even barring on the tail.

Ictinaetus malayensis—Black Eagle
At least four individuals were seen around Lumle 25-26 July.

Torgos calvus—King Vulture
A single bird seen in the hills above Pokhara.

Aegypius monachus—Black Vulture
One individual flew close overhead in open hill country between Lumle and Pokhara on 6 August. This is apparently a very early record for this uncommon winter visitor (Fleming—in litt.).

Gyps himalayensis—Himalayan Griffon
One near Pokhara. The huge size and pale coloration are distinctive.

Gyps bengalensis—Whitebacked Vulture
Pokhara and Lumle, seen at up to 2400 m.

Neophron percnopterus—Scavenger Vulture
Pokhara and Lumle, up to 1850 m.

Gypaetus barbatus—Lammergeier
Seen several times at Lumle at 1900 m, 25th and 26th July, and two together on 5th August. Ghandrung, one on 3rd August.

Spilornis cheela—Serpent Eagle
Seen commonly from the hills above Pokhara up to Chhumrung at 2900 m.

Falco peregrinus—Shahin Falcon
Two pairs and a single bird in a range of open, rocky hillside north-west of Pokhara at 1350 m. One pair were indulging in the impressive display flight; as one bird circled around high in the air, a second rose to join it, and then both swooped down the hillside in a great rush, actually rolling over in mid flight and showing the rusty coloured underparts.

Falco tinnunculus—Kestrel
Seen near Pokhara 23 July, and at Chandrakot 4 August.

Ardeola grayii—Pond Heron.
Kathmandu.

Bubulcus ibis—Cattle Egret
Kathmandu.

Egretta grazetta—Little Egret
Kathmandu and Pokhara.

Lophura leucomelana—Kaleej
Six females supposed to be of this species flew over a path in the Gokarna reserve from one hillside to another.

Treron sphenura—Wedge-tailed Green Pigeon
A male and two females together in a tree at Khuldi at 3000 m on 2 August.

Streptopelia tranquebarica—Red Turtle Dove
Gokarna Reserve, Kathmandu.

Streptopelia chinensis—Spotted-necked Dove
Common around Kathmandu and Pokhara.

Coracias benghalensis—Indian Roller
Pokhara.

Halcyon smyrnensis—White-breasted Kingfisher
Gokarna Reserve, Kathmandu.

Collocalia brevirostris—Himalayan Swiftlet
Common over river valleys from around 1300 m near Pokhara up to 3800 m above Hinko cave, where there was a single bird flying around in driving rain. There is a paucity of records in the literature for this species, and although Scully in 1879 mentioned it as being common on the hills round the Nepal valley from 1830 m upwards, more recent observers have not elaborated much on the position in print. Smythies (*JBNHS 47*:442) found parties over the Gandak-Kosi watershed in September, and Proud (*JBNHS 50*:365) found it there in spring. This is some 140 km eastwards. Fleming (in litt.) says "we have found it quite common" but does not say where. It is a small

swift, the wings not being as sharply pointed as in *Apus*, and the tail showing a slight fork only when closed, but generally looking square or even rounded when the bird is banking. As remarked in the HANDBOOK the flight at intervals becomes suddenly very fluttery. Although the bird can look very dark against the sky, it is actually brownish-grey, the head, body and wing coverts being darker, and the rump and under tail coverts lightest, contrasting with the dark tail.

Apus affinis—House Swift

Common around Kathmandu and Pokhara.

Hemiprocne longipennis—Crested Tree Swift

One was watched hawking over a glade in the Gokarna Reserve on 22 July. Biswas (*JBNHS 58*:120) only lists three specimens, from the central bhabar and dun biotopes, and I cannot find a record of this species from the Nepal valley. There was no possibility of a mistake in the identification, and I am familiar with the species from northern Thailand.

Megalaima virens—Great Barbet

One was seen in surprisingly open countryside with scattered trees near a small village above Pokhara at about 1350 m.

Megalaima franklinii—Golden-throated Barbet

Seen and heard fairly commonly from Lumle at 2000 m to Chhumrung at 2500 m. Not in the Gokarna Reserve.

Megalaima asiatica—Blue-throated Barbet

Common in the Gokarna reserve, and in the hills north-west of Pokhara.

Megalaima haemacephala—Coppersmith

The unmistakable call of this bird was heard at Pokhara, 7 August.

Picus canus—Blacknaped Green Woodpecker

One watched for some time in the Gokarna Reserve.

Dendrocopus darjellensis—Pied Woodpecker

Seen near Khuldi at 2500 m.

Dendrocopus auriceps—Brown-fronted Pied Woodpecker

Several around Lumle and Chhumrung at up to 2350 m.

Dendrocopus canicapillus—Pygmy Woodpecker

Two in the Gokarna Reserve 22 July.

Picumnus innominatus—Speckled Piculet

Several seen in mixed flocks around the hills above Lumle at about 2000 m, 25th and 26th July.

Hirundo rustica—Swallow

Seen at Kathmandu on 22 July and 8th August, and at Pokhara 6th and 7th August.

Hirundo daurica—Redrumped Swallow

Common at Kathmandu and Pokhara, but not seen above 1800 m.

Delichon nipalensis—Himalayan House Martin

Seen commonly above river valleys and woods from about 2000 m near Lumle, but much scarcer above 2800 m. Fleming & Traylor (1968:168) seem to have been first to record this species from central Nepal, and on the previous page published the first record of *Delichon urbica*—the House Martin—from western Nepal. The present species is quite easily told in flight by the square tail, and both upper and under tail coverts being black. This results in a narrower white rump band above, and the base of the black underside of the tail looks more "squared-off' below (Fig. 1).

Motacilla cinerea—Grey Wagtail

Seen commonly by streams from Lumle to Chhumrung.

Anthus novaeseelandiae—Richard's Pipit

Three in a wet grassy area of the Gokarna Reserve.

Anthus similis—Brown Rock Pipit

Several near Pokhara, 6th and 7th August,

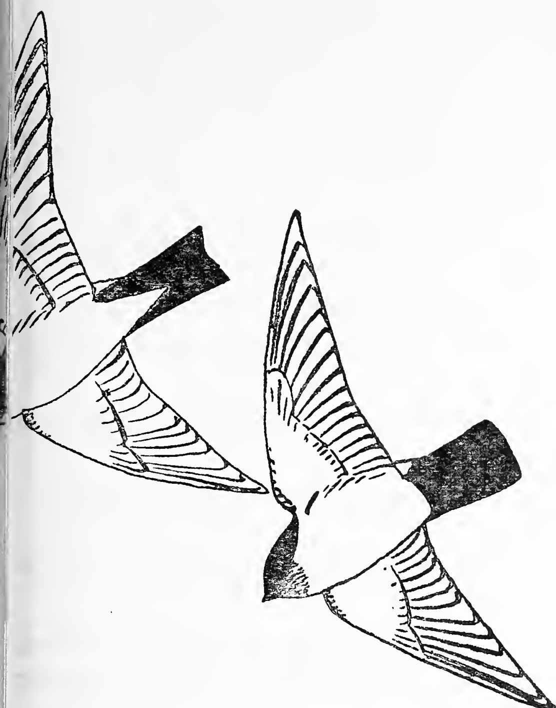

Fig. 1. Diagram to show different pattern of black and tail shape.
Above: Kashmir House-Martin—*Delichon urbica cashmeriensis; Below*: Himalayan House-Martin—*Delichon nipalensis nipalensis.*

one by the airport. This is a fairly large and rather pale brown pipit, lacking the heavy dark streaking above and below of *A. novaeseelandiae* and *A. sylvanus.*

Anthus sylvanus—Upland Pipit
Two seen, both in open rocky areas, one above Pokhara at 1350 m the other near Lumle, at 1900 m.

Pericrocotus ethologus—Longtailed Minivet
Small party of females and/or young males watched at Khuldi at 1900 m. They showed only a small patch of yellow on the forehead, and whitish cheeks and throat, contrasting with the underparts.

Pycnonotus leucogenys—White-cheeked Bulbul
Common. More of a forest bird than *P. cafer.*

Pycnonotus cafer—Redvented Bulbul
Common, up to nearly 2000 m.

Hypsipetes virescens—Rufous-bellied Bulbul
Seen at 1950 m at Lumle.

Hypsipetes madagascariensis—Black Bulbul
Several parties at Lumle and above Pokhara.

Chloropsis hardwickii—Orange-bellied Chloropsis
Seen above Biritante at 1200 m.

Lanius schach—Blackheaded Shrike
Common up to 2300 m.

Copsychus saularis—Magpie Robin
Common in the Nepal valley, but not seen elsewhere.

Rhyacornis fuliginosus—Plumbeous Redstart
Common by streams from Biritante to Chhumrung.

Enicurus maculatus—Spotted Forktail
Several adults and at least one immature seen by Ghandrung on 28th July and 3-4 August. Although this is obviously a resident species, there do not seem to be many summer records.

Saxicola torquata—Stonechat
Several in the Gokarna Reserve, and from Pokhara to Ghandrung.

Saxicola caprata—Pied Bush-chat
Gokarna Reserve and Pokhara.

Saxicola ferrea—Grey Bush-chat
Seen commonly about Khuldi and Ghandrung, but not below about 2000 m.

Monticola rufiventris—Chestnut-bellied Rock Thrush
An immature male and a female seen at Khuldi at 2500 m.

Myiophoneus caeruleus—Whistling Thrush
Common by rivers and streams from 1300 m at Pokhara to about 3000 m near Khuldi.

Zoothera mollisssima—Plain-backed Mountain Thrush

Two pairs with fully grown young frequenting forest edge near the new large sheep pen on the hillside at Khuldi, at 2900 m. They tended to be shy, but could with care be watched at close quarters.

Zoothera dauma—Small-billed Mountain Thrush

A single bird in the same locality as the previous species. There seem to be very few summer records.

Turdus boulboul—Grey-winged Blackbird

Several around Khuldi, at 2800 m.

Pomatorhinus ruficollis—Rufous-necked Scimitar Babbler

In small parties near Lumle at 25th July at 2000 m and on 27th July at Chhumrung at 2200 m.

Pomatorhinus erythrogenys—Rusty-cheeked Scimitar Babbler

One at Lumle.

Stachyris ruficeps—Redheaded Babbler

One bird of this species was seen at 1800 m at Lumle with a party of other small birds including *Phylloscopus* spp. and Grey-headed Flycatchers, Nuthatches and Red-headed Tits. The combination of lemon yellow throat and underparts and the bright brown forehead were distinctive. A good view was obtained as the birds hunted through bamboo and bushes by a stream gulley. The species has only been recorded a few times from Nepal, and has hitherto thought to be confined to the Mai valley in the east of the country.

Garrulax albogularis—White-throated Laughing Thrush

Common around Lumle up to 2000 m.

Garrulax moniliger/pectoralis

A bird which was either the Necklaced or Blackgorgeted Laughing Thrush was seen with several other birds in bushes above Lumle at about 1750 m on 26 July. Fleming (in litt.) comments that this is high for either of these species, although Proud recorded both at 1675 m in June in the valley (*JBNHS 48*: 699).

Garrulax leucolophus—White-crested Laughing Thrush

Common at Lumle.

Garrulax rufogularis—Rufous-chinned Laughing Thrush

A small party of four birds at Lumle, 27th July.

Garrulax ocellatus—Whitespotted Laughing Thrush

Several at Chhumrung, at about 2750 m on 29th July.

Garrulax lineatus—Streaked Laughing Thrush

Very common around Lumle, Ghandrung and Khuldi.

Garrulax erythrocephalus—Red-headed Laughing Thrush

Several seen at Khuldi at 2800 m.

Leiothrix lutea—Redbilled Leiothrix

Several were found in song in damp gullies around Ghandrung and Khuldi at about 2700 m.

Pteruthius xanthochloris—Green Shrike Babbler

One in a mixed flock at Khuldi at 2800 m. It looked like a tubby and large-headed *Phylloscopus* with a short bill, until studied more closely.

Actinodura nipalensis—Hoary Barwing

Seen twice near Khuldi, at 2700 m.

Minla strigula—Stripe-throated Siva

Common in mixed flocks around Khuldi.

Yuhina flavicollis—Yellow-naped Ixulus
Common around Lumle at over 1830 m and also Ghandrung and Khuldi.

Yuhina gularis—Stripe-throated Yuhina
Seen near Biritante at 1330 m, and also at Khuldi.

Yuhina zantholeuca—White-bellied Erpornis
Twice seen in the Gokarna reserve, on one occasion singing a short little snatch of rather undistinguished notes. If this was the song—which is as yet unrecorded—it is unimpressive.

Alcippe vinipectus—Hodgson's Fulvetta
Seen quite commonly around Khuldi above 2800 m.

Heterophasia capistrata—Black-headed Sibia
Common in forest from Lumle at 1400 m to Khuldi at about 3000 m.

Phylloscopus maculipennis—Grey-faced Willow Warbler
Several seen around Khuldi and at Hinko cave at 3500 m. One bird was watched at close range feeding a wing-fluttering but fully grown youngster. The habitat was mixed deciduous forest, with rhododendron, and also in soaking wet dwarf bamboo.

Phylloscopus reguloides—Blyth's Willow Warbler
Seen satisfactorily on several occasions at Lumle and Khuldi, and although some other unidentified species were noted, including a larger species with a single wing bar, this seemed to be the commonest.

Seicercus burkii—Black-browed Flycatcher-Warbler
One at Khuldi on 2nd August.

Seicercus castaniceps—Chestnut-headed Flycatcher-Warbler
Several seen in mixed flocks around Khuldi.

Seicercus xanthoschistos—Grey-headed Flycatcher-Warbler
Very common around Lumle, Ghandrung and Khuldi. Also in the Gokarna reserve.

Prinia criniger—Brown Hill Warbler
Several birds singing from maize stalks in terraced fields near Ghandrung.

Ficedula westermanni—Little Pied Flycatcher
Several adults and immature birds around Lumle at the end of July.

Niltava sundara—Rufous-bellied Niltava
An adult with an immature at Khuldi, and an immature in the Gokarna reserve on 8th August.

Muscicapa rubeculoides—Blue-throated Flycatcher
A male in the Gokarna reserve, 8th August.

Muscicapa moniliger—White-gorgeted Flycatcher
An adult of this distinctive, rather round little Flycatcher, and several less distinct juveniles around Lumle, 25th July.

Muscicapa thalassina—Verditer Flycatcher
Quite common at Lumle, Ghandrung, Khuldi and also in the Gokarna reserve.

Culicicapa ceylonensis—Grey-headed Flycatcher
Common from Lumle to Khuldi, and also in the Gokarna reserve.

Rhipidura hypoxantha—Yellow-bellied Fantail
One in a mixed party above Khuldi at 3000 m on 1st August.

Parus major—Grey Tit
One was watched as it fed in a maize field at 1650 m near Lumle on 24th July. Although commonly recorded from the lowlands this seems an unusual locality, but perhaps some records have not got into print.

Parus monticolus—Green-backed Tit
Common in forest, around Lumle, Ghandrung and Khuldi to 3000 m.

Parus xanthogenys—Yellow-cheeked Tit

In similar habitats, and also seen in the Gokarna Reserve.

Sylviparus modestus—Yellow-browed Tit

Several in mixed flocks above Khuldi at 3000 m.

Aegithalos concinnus—Red-headed Tit

Not uncommon at Lumle and around Ghandrung.

Sitta castanea—Cinnamon-bellied Nuthatch

Two birds together in the Gokarna reserve, 22nd July.

Sitta himalayensis—White-tailed Nuthatch

Common in hill forests, singly and in mixed parties, around Lumle and up to 2800 m at Khuldi.

Sitta frontalis—Velvet-fronted Nuthatch

One in the Gokarna reserve, 8th August.

Certhia himalayana —Himalayan Tree Creeper

One seen prospecting an old, gnarled rhododendron near Khuldi on 1st August at 2800 m. The cross-barring on the tail could be seen when looked for, but was not especially conspicuous. I am fairly happy about this identification as I had only recently been painting Himalayan Tree Creepers from Museum skins. If correct, it is a very interesting record as this species is supposed to have a discontinuous distribution in the Himayalas, apparently being absent between west Nepal and northern Burma.

Dicaeum ignipectus—Firebreasted Flowerpecker

Near Ghandrung at 2500 m.

Dicaeum melanozanthum—Yellowbellied Flowerpecker

Males seen several times near Khuldi at 2900 m usually adorning the very top of a tree, and twitching rather mechanically from side to side.

Dicaeum erythrorhynchos—Tickell's Flowerpecker

One or two in the Gokarna Reserve, 8th August.

Dicaeum concolor—Plain Flowerpecker

Seemed rather commoner in the Gokarna reserve than Tickell's and easily told in a good view by the thin, curved dark bill.

Aethopyga gouldiae—Mrs. Gould's Sunbird

A male above Ghandrung at 2200 m, 29th July.

Aethopyga nipalensis—Yellow-backed Sunbird

Seen near Ghandrung and Khuldi, at around 2500 m.

Aethopyga saturata—Blackbreasted Sunbird

Males seen at Lumle and at Chhumrung, at 2100 m.

Zosterops palpebrosa—White-eye

Two in the Gokarna Reserve, 8th August.

Melophus lathami—Crested Bunting

A female was seen in the little terraced fields at Biritante at 2100 m on 28th July.

Carduelis spinoides—Himalayan Greenfinch

Not uncommon in maize fields in the Ghandrung-Chhumrung area.

Lonchura malacca—Chestnut-bellied Munia

Two in wet grassland at Gokarna.

Passer domesticus—House Sparrow

The House Sparrow was not seen higher than Lumle, at 1800 m.

Passer montanus—Tree Sparrow

Not seen above Chhumrung at 2150 m.

Sturnus malabaricus—Grey-headed Myna

Pokhara.

Acridotheres tristis —Common Myna

Seen at up to 3300 m near Chhumrung.

Acridotheres ginginianus—Bank Myna

Seen between Kathmandu and the Gokarna reserve. This species does not seem to have been recorded from the valley, but here again perhaps the records have not got into print.

Acridotheres fuscus—Jungle Myna
Several around Pokhara, 7th July.

Oriolus oriolus—Golden Oriole
One in a large tree near Pokhara lake, 7th August.

Oriolus traillii—Maroon Oriole
One in forest near Biritante, at 1200 m.

Dicrurus macrocercus—Black Drongo
Kathmandu, Pokhara.

Dicrurus leucophaeus—Grey Drongo
Common in the Gokarna Reserve, and around Lumle, to 2300 m near Chhumrung.

Dicrurus remifer—Lesser Racket-tailed Drongo
A single bird (with only one racket) near Lumle.

Dendrocitta formosae—Himalayan Tree-Pie
Seen near Lumle, Biritante and Ghandrung.

Corvus splendens—House Crow
Kathmandu, Pokhara.

Corvus macrorhynchos—Jungle Crow
Seen commonly above 1300 m near Pokhara to Chhumrung.

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A population survey and observations on the behaviour of the blackbuck in the Point Calimere Sanctuary, Tamil Nadu[1]

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(*With three text-figures*)

One of the largest reported populations of the Blackbuck (*Antilope cervicapra cervicapra*) survive in the Point Calimere sanctuary in Tamil Nadu. J. C. Daniel of the Bombay Natural History Society censused this population in May 1967 and estimated 750-800 animals in the population. Considering the general rapid decline of all wild life in India, a detailed survey of the same population and a pilot investigation of the behaviour of the animal in its natural habitat were undertaken in the second half of October, 1974.

Field descriptions of the behaviour of this animal are almost totally lacking excepting Schaller's account (THE DEER AND THE TIGER, 1967) of the herd in Kanha numbering less than 20 in 1964-65 and a few other fragmentary reports.

Point Calimere (Kodikkadu) (10°18′N, 79° 51′E) is a sandy promontory on the east coast of Tamil Nadu in the Tanjore District, the protected area of which is over 4120.70 acres having a very specialized ecosystem described in detail by Daniel [*JBNHS 64*(3), 1967] and Blasco [*JBNHS 70*(2), 1973].

Daniel found the herd strength at Point Calimere to range in between 3 and 47, the normal being a dozen. He recorded 47 herds in the sanctuary, of which six were inside the forest. In all natural populations studied, the sex ratio favoured the female.

Method of survey

The antelope are mostly found in the wide open grassy meadows dotted with thickets. They do not permit approach to nearer than about 300 yards and once put to flight may cover long distances at top speed.

Direct visual counting was done and a suitable route determined, zigzagging from one end to the other end of the sanctuary dividing the maidan into triangular plots (Fig. 1). Herds were stalked and approached with the least disturbance to the animals, and counting, sexing and classification done with the help of 7 × 50 binoculars from each of the sides of the triangular plot. Such surveys were conducted on the 19th, 22nd and 27th, and on the 27th the same route was backtracked and counting repeated to check movement of animals. Since the herds on the eastern side were

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found to be very stable in both location and numbers, further repeated countings were done only on the southern part. On consecutive days in the forenoons and afternoons alternately the herds in plots 1 to 9 were counted and on the 24th, 26th and 29th, the meadows in the forest were thoroughly checked.

Though the sex of an adult could easily be distinguished, it was found more difficult in the case of yearlings, unless the spike horns were discernible in males. Similarly yearling females lying down were difficult to distinguish from adult females.

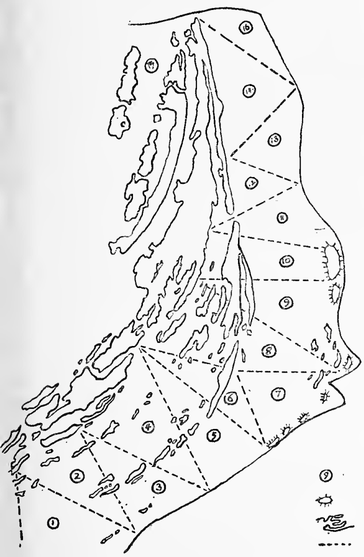

Fig. 1. Map of census plots.

During the survey 54 sightings were made of heterosexual groups, ranging in strength from 2 to 129; and 26 unisexual groups were seen, 17 of which were of males alone. Solitary animals were seen only five times of which only one was a female. Analysis of the data from the population studies shows the average strength of heterosexual herds to be 23, of female herds to be 15 and of male herds to be 4. From Table 1 it can be seen that stable herds number about 8 to 10. In the population, males including yearlings form 17.52 per cent and females 82.47 per cent i.e. the sex ratio of the population is 1♂:4.7♀. Of the males numbering 58, 12 were yearlings, 7 to 9 two-three year olds, and three were mature but pale brown in colour perhaps due to pelage moult or were permanently light coloured. The two-year old males have broadly curved horns in place of the spike horns of yearlings and are darker. Females totalled 273 of which 15 were subadults. Only 2 fawns were seen possibly because the census was just before the birth peak.

Comparison of this estimate with that of Daniel, where the sex ratio was 1:2 and one out of every 11♀ was accompanied by a fawn, shows the general trend of the population. In 1967 according to Daniel 5.81 per cent of ♂ and 26.08 per cent of ♀ were yearlings and the subadults formed 17 per cent of the total population, but in 1974 the subadults formed only 8.88 per cent, a decline by half. But the ratio of male to female yearlings does not show any great discrepancy. It is 1:1.25 compared with 1:1.5 in 1967. Of the females 7 were obviously pregnant (Table 1).

It could clearly be seen that in spite of the fact that the population is inside a sanctuary, the last six years have shown only a drastic and tragic decline of the population, especially of the magnificent bucks—truly the most beautiful of all antelopes. The very low percentage of subadults also shows an undesirable, unhealthy trend.

Herd structure, Size and Composition

Of the total of 85 animal sightings during the survey, 80 were of 2 or more animals. Herd strength varied from 2 to 129 with a mean value of 23. The large numbers of frag-

mentary herds with about 5 to 8 animals each, recorded from the disturbed plots No. 1 to 4 may possibly be a recent development. 34 out of the 54 heterosexual herds seen had one adult male and 11 had two. In herds with more than one adult male, intermale relationships are unknown. Though all older literature notes the leadership of an old female in the herd, no evidence was found substantiating it. Often when herds start running, a doe with a kid will take the lead, if there is one such present. Males wander away from herds especially in the evenings when the females become less active. Females generally do not show any tendency to follow males,

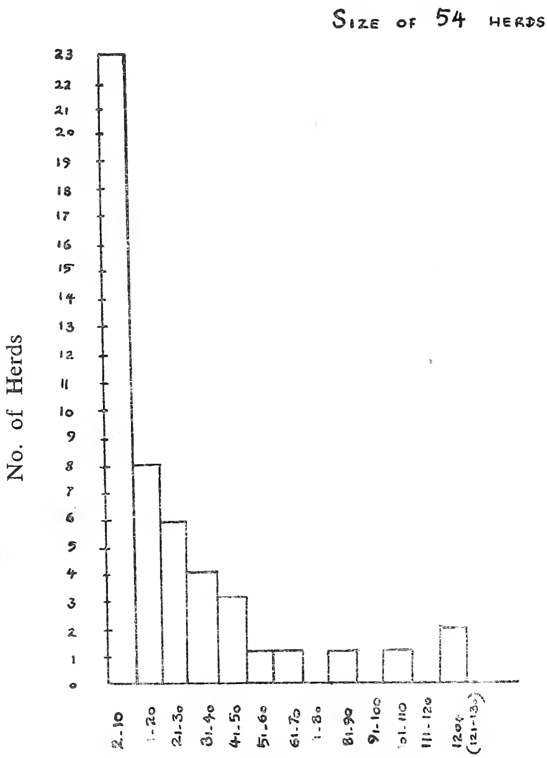

Fig. 2

No. of Animals/Herd

but on a few occasions some females were seen following a male, which moved away from the herd. Does may have both a yearling and a fawn with them as was seen in two of the recorded instances. Of the three fawns one was suckling actively while the other two were being prevented by the mothers from suckling. (Fig. 2).

SOCIAL BEHAVIOUR

Blackbuck social organization is typical of antelopes and consists of harems, normally with one male and a large number of females and young forming a herd during the reproductive season, and mixed, loose herds at other times. They have a well demarcated territory. Even though the survey was conducted in the nonrutting season, the keeping of the territorial boundaries indicates that at least the reproductive territory nucleus may be a permanent feature. This is most clearly suggested by the herds in plots 9 to 15. In the southern half of the sanctuary the territorial organization has broken down, perhaps due to large scale encroachments by villagers into plots No. 1 to 3, causing behavioural disruption, and due to pressure exerted by ousted animals on the adjacent herds. The natural reorganization prior to harem formation may be the causative factor.

The normal range of movement of herds was surprisingly small in stable territories. For example, the herd of 110 + animals in plot 10 could always be found within an area less than 500 metres across. Even in the more disturbed areas animals tend to return to the original locations soon. The conclusion of Schaller that cyclic dis-organization and re-organization of population correlated with rut, needs further study before acceptance in the case of the Point Calimere population.

TABLE 1

DISTRIBUTION PATTERN OF THE BLACKBUCK (*Antilope cervicapra*) IN POINT CALIMERE SANCTUARY

Date of survey	Plot Numbers										
Oct., 1974	1st	2nd	3rd	4th	5th	6th	7th	8th	* 10th	* 12th	* * 15th
19th	2B♂	1B♂ 5♀	10♀	8B♂ 12♀	38♀ 13♀	2B♂ 4♀ 1f	Not Surveyed				
21st	2B♂	1B♂ 7♀	4♀ 1♂ 32♀ 5Ye♂ 1f		11♀ 6B♂ 5B♂ 2B♂ 82♀	1B♂ 1♀ 6♀	1B♂ 7♂ 1♀ 2B♂	1B♂ 1♀ 1B♂	4B♂ 105♀	1B♂ 20♀	1B♂ 19♀
22nd	2B♂	1B♂ 4♀		7Y♂ 1B♂ 1B♂ 10♀	3B♂ 41♀ 1Ye ♀	1B♂ 17♀ 1ye♂	1B♂ 1♀ 2B♂ 3♀	Not Surveyed			
23rd		1B♂ 5♀ 1B♂1y♂1♀ 1B♂ 1♀	1B♂ 8♀ 2B♂ 10♀		3B♂ 29♀			1B♂ 12♀ 1B♂ 3♀		Not Surveyed	
24th		Not Surveyed			9♀	1B♂ 40♀	Not Surveyed				
26th		Not Surveyed				3B♂ 65♀ 1Ye♂ 2B♂ 2Ye♂	Not Surveyed				
27th	2B♂ 3♀ 1ye♀	1B♂ 2♀ 5B♂ 9y♂	1B♂1♀ 4B♂	1B♂ 9♀	1B♂ 56♀ 3f 5B♂	1B♂ 26♀ 1Y♂ 5B♂ 3B♂ 1♀	1B♂ 1♀ 5B♂ 1♀ 2B♂	1B♂ 1♀ 1B♂	4B♂ 108♀ 3Ye♂ 14Ye♀	1B♂ 20♀	1B♂ 14♀
27th (Recount)	2B♂ 9♀	2B♂ 4♀	1B♂ 6♀ 1B♂ 31♀ 1Ye♂		1B♂ 46♀ 2Ye♂ 1f 1B♂ 28♀ 2ye♂		7B♂ 1B♂ 1♀	3B♂ 1Y♂	4B♂ 120♀ (U.C.)	2B♂ 2B♂ 20♀	2B♂ 20♀
29th		Not Surveyed				1B♂ 1y♂ 26♀ 2Ye♂		1B♂ 40♀ 4ye♀			

Key: B♂ = Black Male; Ye = Yearling; (u.c.) = Unclassified; Y♂ = Yellow Male; f = fawn * No animals in plots 9, 11, 13 and 14.

Territorial marking and defence

All territories have characteristic 'Scrapes' i.e. shallow depressions about 20 cm deep, 80 cm long and 30 cm wide dug by males with the hooves of the fore legs, digging 2-3 times each with first one and then the other. Into this depression the animal urinates and then defecates with characteristic body postures. Though repeated use of the same scrape was not observed, the amount of faecal pellets strewn around indicated this. 'Scraping' seems to be a territorial response. In the relatively less disturbed plots, territories have fewer scrapes, but they are numerous in others. Disturbances like intruding cattle and men, caused the male to 'scrape' and this was usually done at one end of the bunched up herd. Males usually vocalised and 'chase displayed' or 'neck thrust displayed' after marking. The frequency of this response could be as high as 3 times in 10 minutes.

No employment of the pre-orbital gland for marking was noted though Schaller cites specific instances.

Intermale fights for territorial possession may take place only at the onset of rut, no instance of which was observed. But on one occasion, alarmed by a large group of tribals, a herd fled from the sea-shore to the forest edge, a distance of more than one kilometre and into the midst of another grazing herd. There was a short bout of fighting between the two males lasting about three minutes. Once when a grazing mixed herd was approached by a group of three males the master buck walked up to the approaching males. They then turned and moved away.

The yearling males were being driven out of the herd territories by the master bucks during the period of observation. The former seem to form bachelor herds. One such herd of 7-9 males all 2-3 year old was consistently observed in plots 2 to 4, possibly due to the absence of defended territories there. They established a hierarchy as evidenced by the frequent sparring bouts. Two animals interlock their horns and push against each other. They also employ the neck butt, a quick jab at the opponent's neck with the horn base. The one that gives ground either flee, or returns for another bout. Both shake heads laterally interlocking horns, all the while flipping their tails and ears. Bouts last from a few seconds to 3 minutes. This subadult sparring seems to differ from adult agonistic behaviour where opponents stand apart and brace their legs and ram the horn bases violently together. The interlocked horns are jerked sideways. On one occasion a black male locked horns with a 2-3 year old male and pushed it back a few metres and then jabbed it in the stomach. The younger animal fled. Agonistic behaviour of this type was not observed between females. Twice jabbing of flank with the head was observed, but usually head shaking directed at another sufficed to move the latter out of the way.

Display behaviour

In mixed herds a 'chase display' was observed, where the male approaches a group of grazing females usually at one end of a dispersed herd in a characteristic prancing manner with head thrust forward and upward so that the snout points to the front and the horns are laid parallel to the neck. Ears are directed back and down showing the white inner hair. Usually, the females start moving out of the way, but one would start running ahead with the male in hot pursuit. They run in an arc back to the herd. This seems to help in keeping the herd compact, or it may be dominance assertion. Males at times butt the females lying

down while starting the run. Each such chase display lasts 15-70 seconds. Males may thrust horns into the soil and throw up loose earth while running.

A similar behaviour could be seen in herds when closely approached by human beings. A female starts running at a high speed suddenly and the male follows. They circle the herd or move away and the male appears to outflank the female while running alongside. This display is more prolonged than the former and the whole herd stands alert during this. This could easily be mistaken for sexual pursuit.

Males were noted rubbing the forehead on the ground nine times. This may be a scent marking behaviour or a display.

Vocalization:

Blackbucks are not very vocal. Though Brander records three types of vocalization by them, only one sound pattern was heard during the observation period. Males produce a deep, low pitched throaty cough or bark 'huf huf' repeated 3-6 times in 2-12 seconds.

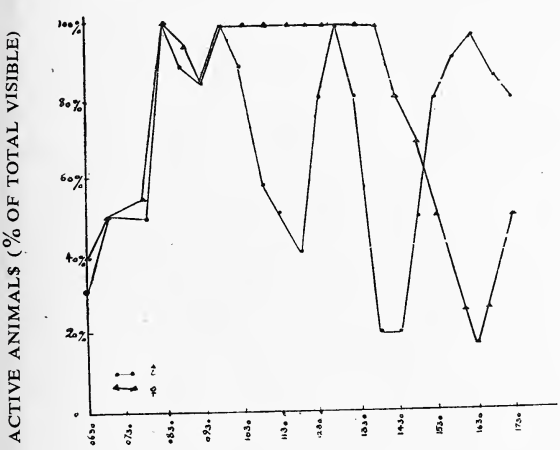

Fig. 3

ACTIVE ANIMALS AT VARIOUS TIMES OF THE DAY

This seems to have a territorial dominance assertion function.

Gait:

When feeding they move slowly but may frequently walk briskly when moving to better pastures. They may even break into a trot spontaneously. But put to flight, they run with incomparable speed and agility. The fluid motion is interrupted by a series of astounding leaps—"stotting" or "spronking". In this all the four feet are bunched together and the animal lands on the hooves simultaneously producing an audible 'thump'. This leaping may serve to increase the field of vision for a plains-dweller for whom death may lurk behind any clump of grass, or to alert conspecifics through visual, auditory or olfactory signals or may serve to deflect the aim of a pursuing enemy.

Activity pattern and rest:

The activity pattern of the antelope was recorded by noting the number of animals observed every 5 minutes to be on the move of the total visible. The observations for each 30 minute period were clumped together and expressed as per cent animals active. Data was recorded from 6.30 a.m. to 5.30 p.m. and plotted on a graph (Fig. 3). This shows some differences between the activity patterns of females and the rest of the group. Grazing picked up tempo from about 8 a.m. and reached a maximum at 9-9.30 and after a slight decrease reaches a second maximum at 10-10.30. After this in females the grazing gradually fell to a very low level by about 12 noon. But in males the activity continue uninterrupted till about 3 p.m. Females again became maximally active at about 1-1.30 p.m. There was a second period of rest around 2-2.30 and a fourth activity peak at 4-4.30. In males the activity gradually decreased from 2-2.30 p.m. to a very low level at 4.30 and

picked up a little tempo later.

This pattern may show seasonal variation and be also correlated with herd dispersion i.e. maximum dispersion just before activity drops off and minimum at rest. Males spend a good deal of their recorded active time not in grazing but in herding together the females and displaying. So possibly they graze during the night too.

Cud chewing was at the rate of 3 chews/2 seconds and females sometimes chewed the cud standing still though males were not seen to do this.

While resting, they fold the legs underneath, resting the head on the flank or stretching the neck and head on the ground. At times the legs are also stretched out.

Their drinking habits are a matter of controversy. Local people assert that they drink sea water. Two males were seen in inches deep sea water out in mud flats but they were never seen actually drinking.

Reproductive behaviour:

Rutting, according to Schaller, may take place throughout the year with two peaks —March-April and August-October. No such peak could be discerned from age distribution of young at Point Calimere. No mounting or copulation was seen, but other reproductive behaviour was observed. Males each with a single female, possibly having deserted their harems were seen in two plots repeatedly. One such male followed the female, smelled the urine she voided and displayed by 'neck thrusting' and curling the lips back ('flehmen'). This was repeated twice. According to local information calving takes place in October. If so the main rut should be in April.

Alarm response to natural predators:

The only natural predator the blackbuck has at Point Calimere is the jackal, the population of which is high. At the close approach of a jackal, resting herds get up and stand alert. In one case a herd moved out of the way and then followed a jackal pair in single file. Females lift their tails in alarm response and urinate. As many as 6 out of a 38 strong herd may urinate simultaneously when alarmed. Females were seen smelling the anogenital area of herd members with lifted tail.

Conclusion

This study was primarily aimed at surveying the population. The recorded behaviour patterns should be evaluated taking into consideration the environmental factors at the locality which may cause normal and abnormal responses in the animals. Many of the interpretations given to recorded behaviour pattern by earlier workers, including Schaller, need deeper study. The population census brings to light the steep decline in the population and behavioural disruption possibly due to disturbances caused by man. This indicates the lack of proper conservation and management of the habitat and the population of this threatened species. Unless corrective steps are taken quickly, perhaps one of the last, large blackbuck herds will also become a memory of the past. This should also be a warning against feeling complacent, trusting the Forest Departments' estimates of wildlife anywhere in India. Approximately 340 animals survive where previous estimates visualise a 1000 + population.

Reptile predators of the Desert Locust[1]

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(*With a text-figure*)

Locust population explosions leading to the periodically of locust cycles had till recently been an unexplained phenomenon. Pradhan (1961, 1965) propounded his Biotic Theory of Locust Periodicity. This theory envisages the predation of locusts by reptilian predators in the locust breeding areas. These areas were also considered to be comparatively more inhospitable than the areas around desert periphery to the predators and the ultimate absence of predators in the desert leads to the population explosions.

In the laboratory (Bhanotar *et al.* 1973), it has been observed that *Uromastix* species hitherto considered a herbivore is a voracious predator of locust. Under simulated laboratory conditions one *Uromastix* has consumed daily, an average 213.3, 164.2, 43.2, 15.1 and 7.6 of first, second, third, fourth and fifth instar hoppers respectively. This predation rate of *solitaries* by *Uromastix* species is definitely significant.

In order to collect data under actual field conditions, several days as well as night surveys were undertaken by the Division of Entomology of the Indian Agricultural Research Institute, New Delhi in two locust sensitive districts of Jaisalmer and Barmer of Thar desert, Rajasthan. These districts comprise mostly of desert soil with patches of hard gravel. The region receives scanty rainfall, averaging between 50-200 mm. However, suitable ecological niches in the form of 'khadin' (Bhanotar *et al.* 1972) provide conditions for *solitaries* to exist throughout the year. Further, after the middle of October enough moisture is available in the Western region of Barmer from fog, which keeps the local vegetation fairly green and moist and sustains the *solitaries* in numerous 'wadis' in that region. These 'wadis' provide less atmospheric disturbance to the *solitaries* and afford excellent opportunities for multiplication leading to population explosion. The vegetation, largely annuals, found in association with locusts are: Bhakra (*Trubulus alatus*); Lana (*Salsoola foetida*); Phog (*Calligonium polygonoides*); Murut (*Panicum turgiodum*); Burut (*Cenchrus barbatus*); Sewan (*Elionurus hirsutus*); Hilra (*Boerhaavia elegans*); Kair (*Boerhaavia* sp.); Kair Monia (*Boerhaavia* sp.); Sawri (*Boerhaavia diffusa*); Siya (*Crotalaria burhia*); Bekar (*Indigofera cordifolia*); Gulia Bekar (*Indigofera* sp.); Dhaveli Bekar (*Indigofera* sp.); Phade (?); Dudeli (*Euphorbia granulata*); Lumph (*Aristida funiculata*); Chog (*Crotalaria* sp.); Lathia (?); Kilonj (?); Ghantil (*Dactyloenicum scindicum*); Mirakh (?); Chapri Kantewali (*Grisekia* sp.); Bui (*Aerua persica*); Bilaj (?); and Kotara (*Corchorus tridens*).

The surveys in these regions, where locust hoppers were recorded 13-15 times during the last 25 years (1939-1963) revealed a picture as visualised in the Biotic Theory. The climatic and thermal conditions (Bhatnagar *et al.* 1973) are actually much more favourable to

[1] Accepted January 1974.

locusts than to predators and also provide no protection to predators against their predators in certain pockets. But there are certain areas suitable for locusts and predators to co-exist and it is in these areas that the locust population remains under check. In areas where the climatic condition are not suitable to the predators but are suitable to the hoppers the locust population exploded during 1970 (at Kharajhanda), 1971 (at Gadra Road) and 1972 (at Chaddi Village of Chohtan Tehsil, Barmer and at Rangowali Sanad near Mohangarh, Jaisalmer).

In these regions the commonly occurring reptiles are *Calotes versicolor* Daudin; *Uromastix hardwicki* Gray; *Acanthodactylus cantoris* Gray; *Ophiomorus tridactylus* Blyth and *Varanus griseus* (in certain localities). Amongst these, *Uromastix hardwicki* Gray hitherto considered a herbivore has been found to be a voracious locust predator (Pradhan 1971). The burrowing scincid *Ophiomorus tridactylus* Blyth has been reported as a locust egg predator (Bhanotar *et al.* 1971 and Bhatnagar *et al.* 1972). The distribution pattern of the five species in the desert deserve attention in view of their predatory role in controlling the *solitary* phase population of *Schistocerca gregaria* Forskal. In the desert *Calotes, Acanthodactylus,* and *Ophiomorus* are ecologically associated with *Uromastix* species occurring in some localities. The species occur in sand dunes without vegetation, where occasionally at their base both juveniles and adults of *Acanthodactylus* and *Calotes* species are seen; in sand dunes with vegetation: *Ophiomorus* species occur at all levels in addition to those found in sand dunes without vegetation; in loose sandy ground with surface vegetation: *Acanthodactylus* along with *Calotes* species are found (the latter in large numbers); in compact sandy loam (cultivated): adults and juveniles of *Acanthodactylus* species are found along the margins and in between the sparse vegetation, whereas in hard soil with vegetation all four species are seen; in rocky areas, mostly *Calotes* and occasionally *Acanthodactylus* occur. It is evident from the distribution that all possible predators including *Uromastix* occur and it is not *Uromastix* alone that plays the role of predator.

Amongst the diurnal reptiles of the Thar desert, the lacertid *Acanthodactylus cantoris* Gray (Bhatnagar & Bhanotar 1973) has the widest contiguous distribution in various niches of locust sensitive areas. The species not only feeds on locust but also on other acridids namely *Spathosternum* sp., *Acrida* sp., *Pyrgomorpha* sp., *Acrotylus* sp., and *Atractomorpha* sp. Its occurrence in large populations among bushes and shrubs and in cultivations harbouring *solitaries* deserves attention in context to its predatory role. This species is also better adapted for heat tolerance and sand conditions due to its small and sleek body size, ability to move on sand, glossy scales and protective coloration.

Our ecological surveys showed that the *Uromastix* habitats occurs in the form of belts

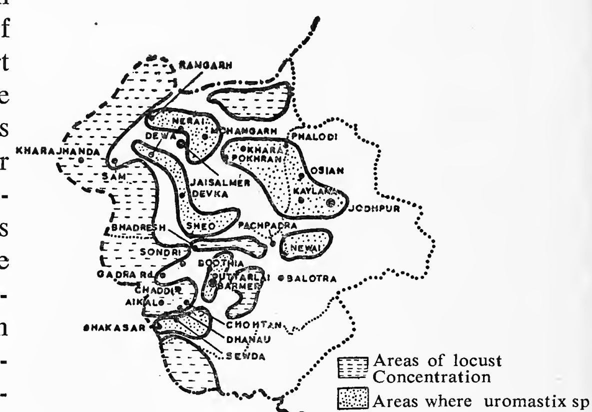

Fig. 1. Distribution of *Uromastix* sp., a locust predator, in the two locust sensitive region of Thar desert, Rajasthan.

(Text-fig. 1). The first belt harbouring the species extends from NW region roughly between 26° and 28° latitude and 70° 9′ and 71° 9′ longitude and second between 71° 9′ and 72° 5′. Thus the north-western upper belt covers the areas of Ramgarh, Nerai and halfway upto Mohangarh. The north-east belt covers the areas of Khara, Phalodi, Pokhran, Osian, Kailana and Jodhpur; a third belt runs somewhat parallel to western locust belt from Dewa, Jethwai in Jaisalmer and from Devka to Sheo. In the SW fringes there are small isolated patches running from Boothia, Sondri and Barmer down to a point half way to Chohtan. The extreme western region harbouring the species covers the areas of Dhanau, Sewda and Bhakasar bordering Gujarat. Other similar patches are to be seen near (1) Uttarlai to Sheo Road, (2) Chipal Talai and Aikal to Bhakasar and (3) Gadra Road (in patches) and around Sam. However, in the areas where the *Uromastix* colonies are located there are certain niches which are ecologically suited for locust multiplication, yet the number of the locust found in these niches are very small. Guts of a number of *Uromastix* and other lizards collected in this belt showed the presence of Acridid remains. There is a difference in the colony pattern of *Uromastix* species of Thar desert and its peripheral areas of Delhi and Haryana state (Bhatnagar *et al.* 1973). Further the number of individuals in the Delhi-Haryana region is much higher than in the above two districts of the Thar desert. This shows that the Thar desert is not a suitable habitat to the reptile compared to its periphery (Bhatnagar *et al.* 1973).

This study makes it possible to pin point and isolate the most susceptible areas in these two locust sensitive districts. If, in these belts predators like *Uromastix* are rehabilitated in suitable niches, reducing their mortality (including the fairly large scale destruction by local tribals) and migration effected by extreme desert conditions there is a great possibility of checking the *solitaries* phase of the locusts exploding into the *gregarious* phase.

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A new species of *Lysaphidus* from India (Hymenoptera; Aphidiidae)[1]

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(*With five text-figures*)

Smith (1944) proposed *Lysaphidus* as a subgenus of the genus *Aphidius* Nees, with *Aphidius* (*Lysaphidus*) *adelocarinus* Smith, as type for having (i) petiole practically parallel sided (ii) metacarp (Rı) short (iii) anterior prong of the second valvulae large and appearing flat from the side and (iv) propodeum bearing carinae. He included four species in the subgenus, namely; *Aphidius* (*Lysaphidus*) *adelocarinus* Smith, *A.* (*L.*) *multiarticulatus* Ashmead, *A.* (*L.*) *ramithyrus* Smith, and *A.* (*L.*) *rosaphidis* Smith, from Nearctic region. Stary (1960) accorded generic status to *Lysaphidus* Smith, and later, he (1960a) described three new species under it, namely, *Lysaphidus schimitscheki* Stary, *L. arvensis* Stary, and *L. erysimi* Stary, from Europe. Mackauer (1962) transferred *Lysaphidus schimitscheki* to the genus *Aphidius*. Takada (1966) added three new species to the genus *Lysaphidus*, namely; *L. pleotrichophori* Takada, *L. matsuyamensis* Takada, and *L. callipterinellae* Takada from Japan. Subsequently, Mackauer & Stary (1967) suppressed *Lysaphidus callipterinellae* as synonym of *Aphidius sicarius* Mackauer. Recently, Dharmadhikari & Ramaseshiah (1970) recorded this genus from India without attributing any species to it.

Lysaphidus qadrii sp. nov.[2]

FEMALE

Head: Dark brown excepting clypeus, malar space and palp segments which are yellowish; setose; wider than thorax (0.40, 0.31 mm); malar space as wide as 1/5 eye length (0.04, 0.21 mm); tentorio-ocular line as wide as 1/3 inter-tentorial line; tentorial pits elongate; clypeoantennal line shorter than facial line (0.12, 0.15 mm); SO:SD:IS = 2:4:3; OOL:POL:AOL = 9:5:3; apical angle of ocellar triangle right angle (Fig. 5); eyes moderate, oval, setose and convergent towards clypeus; clypeus smooth with 6 long setae and separated from face by an arcuate groove.

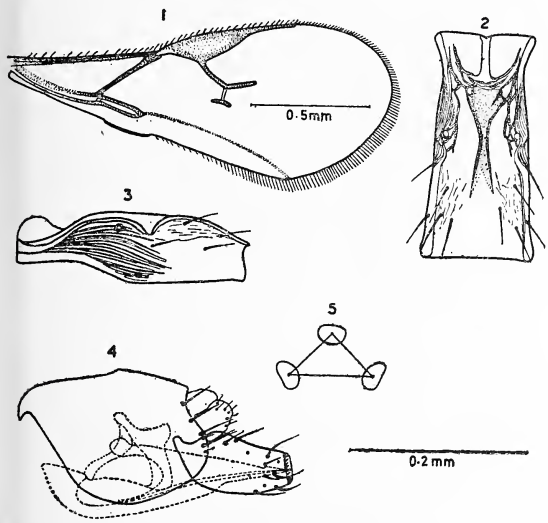
Antennae: Brown, underside of scape and pedicel yellowish; 1.12 mm long; 13 segmented; first flagellar segment somewhat longer than second flagellar segment, parallel sided and two and a half times longer than wide, rest of the flagellar segments gradually thickened towards apex; flagellar segments 2-9 three times longer than wide; penultimate segment shorter than twice width; apical segment almost thrice longer than wide.

Thorax: Dark brown; mesoscutum setose

[1] Accepted June 1976.
[2] This species is named after late Prof. Mohd. Afzal Husain Qadri.

along margins and parapsidal furrows; parapsidal furrows distinct anteriorly and slightly crenulate; propodeum areolated with small and narrow pentagonal areola and strongly developed median carina and transverse carinae, the later reaching upto the spiracles; each upper areola with 4 and lower with 2 setae.

Fore-wings: (Fig. 1) Hyaline; venation brown excepting 2r-m which is hyaline; pterostigma triangular, four times longer than wide; metacarp (RI) almost as long as 1/2 length of pterostigma (0.19, 0.39 mm); first abscissa of r & Rs longer than width of pterostigma (0.14, 0.10 mm).



Figs. 1-5. *Lysaphidus qadrii* sp. nov. (♀): 1. Fore wing, (2) petiole (dorsal view), (3) petiole (lateral view), (4) genitalia, (5) ocelli.

Legs: Brownish.

Abdomen: Brown excepting petiole which is yellowish; petiole (Figs. 2 & 3) two and a half times longer than wide at spiracles, slightly dilated at apex with a central longitudinal carina extending upto posterior third and with small lateral impression posterior to the spiracles; feebly rugose around the spiracles and posterior to the lateral impressions, almost smooth posteriorly; sparsely setose in posterior half; anterolateral area with 16 costulae, spiracular tubercles situated somewhat anterior to the middle of petiole; genitalia (Fig. 4) third valvulae slender with slightly concave dorsal margins.

Length: 2.14 mm.

Holotype: ♀, 1 ♀ paratype, INDIA: Uttar Pradesh, Sitapur; 14-iii-1973; on leaves of *Artocarpus heterophyllus* L.; Coll. Shujauddin.

Lysaphidus qadrii sp. nov. is closely related to *Lysaphidus arvensis* Stary from which it differs by the following characters; (i) apical angle of ocellar triangle right angle (ii) first flagellar segment two and a half times longer than wide (iii) metacarp (RI) as long as 1/2 length of pterostigma (iv) petiole two and a half times longer than wide and (v) third valvulae slender.

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A note on two species of *Ipomoea*, namely *I. carnea* Jacq. and *I. fistulosa* Mart. ex Choisy in eastern Asia[1]

P. K. Bhattacharyya[2]

Two south American perennial, shrubby, ornamentals, *Ipomoea carnea* Jacq. and *I. fistulosa* Mart. ex Choisy were introduced in the gardens of eastern Asia and are now growing wild in the area and have been incorporated in the regional floras. The two species are very similar and have been often confused with each other. To understand their distinguishing characters clearly, detailed morphological, ecological and anatomical studies have been carried out. Floral and fruit-structure of the two species are identical but the habit, leaf structure and anatomy help to distinguish them easily.

Ipomoea carnea Jacq. is recorded from India by several authors (Parker 1918; Haines 1921-24; Bor & Raizada, 1954; Maheswari 1963) and described (Boerl 1899; Koorders 1912; Gagnep & Courch 1915; Backer 1931) and in other east Asian countries but Van Ooststroom (1940) doubted about their authenticity and stated that they had used the name *I. carnea* for the Asiatic specimens most probably wrongly. Haines described it from Bihar and Orissa but stated that he was not sure of the current name of the shrub.

Van Ooststroom (1940) described *I. crassicaulis* (Benth.) Rob. (= *I. fistulosa* Mart. ex Choisy) from Malay peninsula. Hara (1966) described it from eastern Himalayas.

According to Tucker (1930), O'Donell (1952) and Van Ooststroom (1953) by the principle of priority, the name *I. crassicaulis* (Benth.) Rob. is a synonym and *I. fistulosa* Mart. ex Choisy the valid name of the species.

Datta & Majumdar (1966) noted only *I. fistulosa* from Calcutta and its suburbs.

Regarding the capsule and seed structure of *I. fistulosa,* differing reports are available. Glabrous, globose capsule, glabrate seeds were observed by Choisy but according to Van Ooststroom and the author the capsule is ovoid, densely pubescent at the base and seeds are silky villous. Haines' observation of 4-celled ovary of *I. carnea* is an artifact. Bor & Raizada note that 'carneus' means flesh-coloured and refer to the colour of the corolla but Jacquin (1763) observed white flowers.

It is interesting to note that the two species are very close and similar in their floral and fruit-structure. These two south American species were introduced in Indian agri-horticultural gardens as ornamental cultivated plants and their introduction in to other Asiatic countries happened probably in the same way.

I noted that the habit of *I. carnea* varies

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from a true climber to liana condition, and the character of the leaves are very prominent in *I. carnea* along with its almost solid stem. The leaf structure of shrubby *I. fistulosa* is variable but a wide survey reveals that the leaf is sagittate and distinctly acuminate. The young stem of *I. fistulosa* is swollen, milky and hollow.

In connection with taxonomic study of Indian convolvulaceae and from the original descriptions, I am convinced that *I. carnea* along with *I. fistulosa* occur widely in eastern Asia particularly in India and Burma.

Both are lenticellate, pale greyish at maturity, but when young—green, covered with hairs; and have glands at the base of midrib of the leaves. Their common characters are as follows:- Secondary nerves of the leaf parallel, petiole slender; inflorescence axillary, cymose on a long (about 5.15 cm) peduncle; bracts small caducous; calyx persistent, never enlarged; corolla pinkish white; flowers large (7.5-9 cm long), tube constricted close to the base, filaments and style included, stamen unequal, capsule glabrous, ovoid, mucronulate due to persistent style base, brown, four valved, inner side of the capsule wall pearl white, two celled, each cell with two seeds and with an incomplete partition wall at replum from the top of the capsule; seeds large (about 8 mm long, 5 mm broad) subovoid, black, ascending, attached to the base of replum; testa with loose grey, villous hairs which help their dispersal by wind to some extent.

To understand the distinguishing characters more clearly, the detailed morphological, ecological and anatomical studies of these two species have been undertaken and discussed in the present paper.

Ipomoea carnea Jacq:- plants are still confined to gardens. Just after 3-4 successive nodes from the apex—stem becomes greyish and lenticellate. The specific morphological and anatomical features are follows:- Liana or sinistrorse twiner, stem terete, usually solid but short primary pith disorganised at full maturity; at younger parts hairs sericeous but at maturity stem glabrous; leaf entire, margin never undulated, base slightly cordate, shape ovate to suborbicular, apiculate to acute but never acuminate as in *I. fistulosa*; phyllotaxy alternate, 2/5; lamina about 7-12 cm long, 6-11 cm broad; floral tube pale pinkish or whitish or with white spots at tube; stigma oblique, lobes unequal; capsule elliptic or elongated ovoid, tetragonal about 3 cm long, seeds attached to the replum about 3.0 mm away from the base of the capsule; flowering November to April and fruiting from the month of April; epidermal cells small, rectangular; stomata rubiaceous abnormal stomata often present as in some solanaceous plants (Ahmad 1964); stem solid thick cuticulate, epidermis unicellular, cork cells originate from the deeper chlorenchyma tissue when the stem is perfectly green; chlorenchyma thick, angular with distinct large latex vessels; cortical parenchyma large; pith parenchymatous with reserve food grains.

Ipomoea fistulosa Mart. ex Choisy—*I. crassicaulis* (Benth.) Rob.—*I. carnea* auct. non Jacq.—*Batatus*(?) *crassicaulis* Benth.

Very common in waste lands and gardens of India, well adapted for aquatic habitats (as emergent or tenagophyte) and terrestrial conditions; at nodes or internodes, adventitious roots grow profusely; shrubs are erect or after attaining 3 metre height—the stem-tip slightly tends to twine, but in a hedge stem is prostrate and rather weak. The plant is very poisonous and is never touched by grazing animals and is not parasitised by *Cuscuta* (Bhattacharyya 1971). On damp soil, a small piece of branch takes root very easily and so it propagates

quickly without human care. It can be safely used as a fence-plant and may be used as a good soil binder because of its luxuriant growth and adaptability.

The morphological characters of the taxon are as follows:- stem stout, pronouncedly fistulose due to disintegration of broad pith at the initial stage of secondary growth; internodes longer, stout, terete (solid stem due to intact pith at very young primary state); younger parts villous to pilose; leaves long, margin usually undulating, base with conspicuous round lobes or truncate, apex of leaf typically long acuminate, lamina usually 16 cm long and 9 cm broad; inflorescence axillary or terminal; single to many-flowered; stigma, globular, capitate; capsule ovoid glabrous but base without thick pubescent hairs, seeds shorter in size, aborted seeds also observed with normal one, and attached—about 1.5 mm away from the replum base, flowering all through the year; and fruiting observed only from the month of May to November.

The anatomical characters of the taxon are as follows:- epidermal cells big, rectangular to wavy in outline; stomata normal rubiaceous; glands and multicellular hairs on the leaf surface; stem thin cuticulate, epidermis unicellular, cork cells originate just after the epidermal cells, chlorenchyma—3 celled with condensed chloroplast, chlorenchyma thick angular to lacunate (8-9 celled thick), cortical parenchyma large; chloroplast distributed on the side walls of chlorenchyma and cortical parenchyma; latex vessels on cortex and pith; protopholoem fibre in patches; phloem and xylem rays prominent; pith parenchymatous, pith cells gradually reducing in size towards centre; central large parenchyma only disorganised and form fistulose internodes gradually with the openings of the young leaves; no reserve food-grains observed in the pith cells.

Surveying all of these criteria there will be no trouble to identify the two species definitely and it can be confirmed that the description and figure of Bor & Raizada is of *I. fistulosa* not of *I. carnea*.

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(Arranged according to the date of collection).

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Notes on the breeding habits of the Indian sheath-tailed bat, *Taphozous melanopogon* (Temminck)[1]

M. S. Khaparde[2]

The study of the breeding habits of the tropical bats has received attention of biologists more recently after the pioneer work of Baker and his associates (1936a, 1936b), who showed that there are basic differences in the reproductive behaviour between the bats inhabiting cold climates and those living in warm regions. Although India has a rich bat fauna, the details of reproduction are known with respect to only a few species of bats.

A perusal of earlier literature on the subject reveals that the reproductive patterns of bats can be classified into following types:

1. Copulation is immediately followed by fertilization and pregnancy as in *Rhinopoma kinneari* (Anand Kumar 1965), *Megaderma lyra lyra* (Ramaswamy 1961), in many other species of Indian bats (Brosset 1962).

2. Copulation occurs in autumn; the inseminated sperms survive in the female reproductive tract of the hibernating female during winter and fertilize the ova released in the following spring as in *Nyctalus noctula* (Grosser 1903), *Myotis lucifugus lucifugus* (Wimsatt 1942). In *Pipistrellus ceylonicus chrysothrix* (Madhavan 1971) the inseminated sperms survive in the female genital tract and fertilize the ova released about one month after copulation.

3. There is no restricted breeding season, and the breeding occurs throughout the year as in *Taphozous longimanus* (Gopalakrishna 1955), *Desmodus rotundus murinus* (Wimsatt & Trapido 1952).

Collections of specimens of *Taphozous melanopogon* were started in August 1972. *Taphozous melanopogon* is colonial in habit and lives in caves and old temples. Specimens of this species were collected from old temples and caves in and around Bhubaneswar, Orissa, India. Excepting July, specimens were collected in all the months of the year for two consecutive years. Absence of collections in July does not seriously affect the conclusions drawn in the present report. Frequent collections were made during the breeding season, to obtain closely graded stages of development. After killing the specimens, the body weight and the wing span length was recorded. A collection diary incorporating all details was maintained. Majority of the complete specimens were fixed and preserved in 10 per cent neutral formalin. The genitalia were dissected out and fixed in various fixatives such as Bouin's fluid, Cornoy's fluid, Neutral formalin, and were preserved in 70 per cent alcohol. Whenever necessary the male and the female genitalia were dehydrated by passing through graded series of alcohol,

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TABLE 1

SUMMARY OF COLLECTION DIARY

Month/Date	Females				Males		Total
	Non-pregnant		Pregnant	Young	Adult	Young	
	Non-lactating	Lactating					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
January							
10-i-73	8	—	—	—	4	—	12
18-i-74	6	—	—	—	—	—	6
22-i-73	10	—	—	—	8	—	18
25-i-74	8	—	3	—	—	—	11
28-i-73	6	—	8	—	—	—	14
31-i-74	5	—	9	—	3	—	17
February							
2-ii-74	2	—	6	—	—	—	8
5-ii-74	—	—	13	—	5	—	18
13-ii-73	—	—	8	—	5	—	13
20-ii-73	—	—	12	—	5	—	17
March	—	—	23	—	14	—	37
April	—	—	31	—	15	—	46
May							
10-v-73	—	—	8	—	6	—	14
20-v-74	—	—	9	—	10	—	19
27-v-74	—	4	9	1	5	3	22
June							
2-vi-73	—	3	4	—	—	3	10
5-vi-74	—	7	3	4	—	3	17
10-vi-74	—	12	—	5	5	7	29
26-vi-73	—	4	—	2	5	2	13
July			No Collection				
August	9	—	—	—	13	—	22
September	6	—	—	—	9	—	15
October	14	—	—	—	12	—	26
November	30	—	—	—	25	—	55
December	26	—	—	—	37	—	63
Total	130	30	146	12	186	18	522

Foot note:-

1. The word 'Young' has been used in Table 1 to denote those specimens which are attached to the breasts of the mothers.
2. Datewise collection is mentioned in the months of January, February, May and June in support of the conclusion drawn in the present report.
3. The free Immature females and males are included in Table 1 with the non-lactating adult females and adult males respectively.
4. From January to June although more male specimens were caught only a limited number or none (as mentioned in Table 1) were brought to the laboratory. During these months the females and males were found to segregate at different corners within the same colony.

embedded in paraffin, sectioned at a thickness of 10 μ and stained in Haematoxylin-eosin.

A pair of pectoral mammary glands are present one on each side in the female. The teats are distinctly visible in the lactating female.

Table 1 gives the summary of the collection diary. The present report is based on the observations of 522 specimens of *Taphozous melanopogon,* collected for a period of two years. Examination of the total collection of female specimens of *Taphozous melanopogon* reveals that pregnancies as evidenced by the occurrence of bulbous uterine cornua are noticed in this bat from about the last week of January to about the third week of May. Among the eleven females collected on 25th January 1974, three showed unmistakable signs of pregnancy since the right uterine cornua were swollen and richly vascularized. To confirm these findings all the three female genitalia were sectioned, and observed under the microscope. Microscopic examination of the serial sections of the right side of the female genitalia showed the presence of a single corpus luteum of early pregnancy in the right ovary and a blastocyst in the right uterine cornu in each specimen. Progressively from 25th January to 5th February a greater proportion of females had bulbous uterine cornua among the females collected on different dates. Altogether thirteen females were collected on 5th February, and all of them showed unmistakable signs of pregnancy. All females collected between 5th February and 20th May were pregnant, each carrying a single foetus in the right cornu of the uterus. No pregnancy was observed during the other months of the year. On 20th May, nine females were collected and all of them were at very advanced stages of pregnancy. Out of the thirteen females collected on 27th May, four were delivered each carrying a single young attached to the breast, while nine females were still at very advanced stages of pregnancy. All the twelve females collected on 10th June had delivered, each carrying a single young attached to the breast.

The above facts indicate that *Taphozous melanopogon* breeds once in the year in a restricted period, bringing forth a single young during each cycle.

The female reproductive organs of *Taphozous melanopogon* consists of a pair of ovaries, a bicornuate uterus and a vagina. From the last week of January to the first week of June over 140 females were collected and all of them were pregnant. Secondly, in all the pregnant females pregnancy was noticed only in the right cornu of the uterus. It cannot be an accident that even a single immature female specimen could not be obtained during the breeding season. These observations lead to the following conclusions:

1. Although the uterus is bicornuate and morphologically bilaterally symmetrical in this bat the right cornu of the uterus is physiologically dominant over the left in bearing pregnancy.

2. Evidently, all females must be undergoing copulation followed by fertilization and pregnancy since all females collected during the active period were pregnant. This shows that the young females of *Taphozous melanopogon* born in late May or early June become sexually mature by the next January and breed when they are about eight months old. In this regard this bat resembles *Myotis lucifugus lucifugus* (Wimsatt & Kallen 1957) in which the females become sexually mature within the year of their birth.

With regard to sex ratio in this bat the present observations does not permit the author to come to any definite conclusion, since the males and females of this species were found

segregated within the same colony at different corners, during the breeding season.

On comparing the breeding habits of *Taphozous melanopogon* with that of *Taphozous longimanus* (Gopalakrishna 1955) the following important differences in their sexual behaviour are noticed:

(1) While in *Taphozous melanopogon* breeding occurs once in the year in a restricted period, in *Taphozous longimanus* breeding occurs throughout the year.

(2) While in *Taphozous melanopogon* the right cornu of the uterus is physiologically dominant over the left in bearing pregnancy, in *Taphozous logimanus* pregnancy alternates between the two cornua of the uterus in successive pregnancies. It is, thus evident from the above comparison that these two species of bats belonging to the same genus have basic differences in their sexual behaviour which is of great interest. Full details of reproduction and associated phenomena is being studied in this laboratory by the author and will be published soon.

Acknowledgements

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Butterfly fauna of Patna (Bihar)[1]

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Lists of butterflies from the Gangetic plains region of India are available for Delhi (Jandu 1942, 1943; Donahue 1966, 1967), Kanpur (Sevastopulo 1948), Lucknow (de Rhé-Philipe 1902, 1905) and Calcutta (de Nicéville 1885; Sevastopulo 1944). However, there appears to be no list of the butterflies occurring in the Gangetic plains of Bihar. This list is based on the butterflies taken at Patna, from localities inside the city, or from places around Patna falling within a *c.* 70 km radius. The collections are deposited at the Gangetic Plains Regional Station of the Zoological Survey of India, Patna.

In the list below, the total number of specimens collected (till 1972) are shown to indicate the status of abundance of that species in the area, and the months of collection are mentioned to indicate the dry or wet season form of the butterfly and/or the period of occurrence in the area. Recent literature has been followed for the identification and nomenclature of species dealt with.

Family DANAIDAE

Danaus chrysippus chrysippus (Linn.) The plain tiger

More than 60 specimens from Hajipur, Baikathpur (Fatwah), Barh, and Patna during all months.

D. genutia (Cramer) The common tiger

19 specimens from Obra (Gaya) and from Patna during January, February, May, July and September.

D. limniace leopardus (But.) The blue tiger

One specimen collected from Biharsarif, during November.

Euploea core core (Cramer) The common Indian crow

14 specimens during July-October.

Family SATYRIDAE

Melanitis leda ismene (Cramer) The common evening brown

11 specimens from Maner, and Patna during October-December.

Mycalesis mineus polydecta (Cramer) The dark-brand bushbrown

8 specimens from Maner, Islampur, Hajipur, and Patna during July, September, November-December.

My. perseus tabitha (Fabr.) The common bushbrown

5 specimens during October-November.

Family NYMPHALIDAE

Ergolis merione tapestrina Moore The common castor

8 specimens from Hajipur, Maner, and Patna during January, March, April, August-September.

[1] Accepted January 1975.

[2] *Present address*: Lepidoptera Section, Zoological Survey of India, 34 Chittaranjan Avenue, Calcutta 12.

Hypolimnas bolina bolina (Linn.) The great eggfly
One specimen from Phulwarisarif during October.

H. misippus (Linn.) The danaid eggfly
6 specimens from Maner; and from Patna during September-October.

Phalanta phalantha phalantha (Drury) The common leopard
3 specimens from Maner; and from Patna, during April, September and December.

Precis almana almana (Linn.) The peacock pansy
More than 40 specimens collected from Chandwa (Arrah), Maner, Baikathpur (Fatwah); and Patna, during January-May and July-December.

P. hierta hierta (Fabr.) The yellow pansy
3 specimens from Hardinge Park, Patna during October.

P. lemonias vaisya (Fruhst.) The lemon pansy
25 specimens during March, April, July, October and December.

P. orithya swinhoei (Butler) The blue pansy
10 specimens from Chandwa (Arrah), Maner, Daniawan (Fatwah); and Patna, during January, March, May, August-November.

Vanessa cardui (Linn.) The painted lady
One specimen from Baikathpur (Fatwah), during March.

Family ACRAEIDAE

Acraea violae (Fabr.) The tawny coster
11 specimens collected from Koilwar, Maner, Daniawan (Fatwah), Baikathpur, Naubatpur; and Patna, during February-April, and August-September.
The FAUNA OF BRITISH INDIA (Talbot 1947) gives its habitat as Ceylon and Peninsular India only. On the basis of present material and few other earlier records, Varshney (1973) has extended its range to North India.

Family LYCAENIDAE

Catochrysops strabo strabo (Fabr.) The forget-me-not
One specimen from Maner, during January.

Euchrysops cnejus (Fabr.) The gram blue
6 specimens from Maner, Islampur and Baikathpur (Fatwah), during September, November-December.

Lampides boeticus (Linn.) The pea-blue
5 specimens from Barh, Baikathpur and Patna city, during January-March.

Rapala iarbus sorya Kollar The Indian red flash
One specimen collected from Fatwah, during December.

Spindasis syama peguanus Moore The club silverline
One specimen from Kumrahar in Patna, during September.

S. vulcanus vulcanus Fabr. The common silverline
3 specimens from Maner and Kumrahar (Patna), during July, September and November.

Syntarucus plinius (Fabr.) The zebra blue
One specimen from Choti pahari in Patna, during December.

Tarucus callinara Butler The blue pierrot
2 specimens from Baikathpur (Fatwah), and Rampur (Patna), during August and November.

Zizina otis indica Murray The lesser grass-blue

One specimen from Barh, during March.

Family PAPILIONIDAE

Atrophaneura aristolochiae aristolochiae (Fabr.) The common rose
One specimen from Maner, during September.

Papilio demoleus demoleus Linn. The lime butterfly
18 specimens during June-October and December.

P. polytes romulus Cramer The common mormon
3 specimens during March and October.

Family PIERIDAE
Subfamily Pierinae

Anaphaeis aurota aurota (Fabr.) The pioneer
14 specimens from Parev (Koilwar), Maner; and Patna, during April, May and July.

Cepora nerissa phryne (Fabr.) The common gull
More than 40 specimens from Chandwa (Arrah), Parev (Koilwar), Maner; and Patna, during January, March-May and July-December.

Delias eucharis (Drury) The common jezabel
4 specimens from Maner and Patna, during January and October-November.

Ixias marianne marianne (Cramer) The white orange tip
5 specimens from Parev (Koilwar), Maner; and from Patna, during January, March and July-August.

I. pyrene kausala Moore The yellow orange tip-white
2 specimens (♀ ♀), during January.

I. pyrene sesia (Fabr.) The yellow orange tip
3 specimens during April and November.

Leptosia nina nina (Fabr.) The psyche
One specimen from Agamkuan in Patna, during February.

Pieris brassicae nepalensis Doubleday The large cabbage white
2 specimens from Barh, during March.

Valeria valeria anais (Lesson) The common wanderer
5 specimens during August and October-December.

Subfamily Coliadinae

Catopsilia crocale crocale (Cramer) The common emigrant
20 specimens from Maner and Patna, during May and August.

C. crocale pomona (Fabr.) The lemon emigrant
One specimen from Begampur (Patna city), during December.

C. pyranthe pyranthe (Linn.) The mottled emigrant
7 specimens from Konhara (Hajipur); and from Patna; during April and August-September.

Eurema brigitta rubella (Wallace) The small grass yellow
One specimen from Chaitola (Patna), during October. Unusually it was flying at night (Varshney & Nandi 1970).

E. hecabe contubernalis (Moore) The common grass yellow
More than 50 specimens from Arrah, Bihta, Hajipur, Barh, Baikathpur (Fatwah); and Patna, during January-April and June-December.

E. hecabe kana (Moore) The common grass yellow-wet season form

2 specimens from Baikathpur (Fatwah) and Begampur (Patna city), during July and September.

Family Hesperiidae

Badamia exclamationis (Fabr.) The brown awl

One specimen from Bakhtiarpur, during December.

Parnara guttatus bada Moore The straight swift

23 specimens from Arrah, Maner, Barh, Biharsarif, Fatwah, Hajipur; and Patna during June-July and September-November.

Pelopidas mathias mathias (Fabr.) The small branded swift

5 specimens from Barh, Islampur, Maner and Patna, during August-October.

Potanthus pseudomaesa pseudomaesa (Moore) The Indian dart

One specimen from Begumpur (Patna city), during September.

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A botanical trip to Moralkanda (Himachal Pradesh)[1]

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A botanical excursion to the Moralkanda hill tract in Himachal Pradesh in the months of September and October resulted in a collection of 219 specific or infraspecific taxa of which 188 are dicotyledons, 17 monocotyledons, 5 gymnosperms and 9 pteridophytes. Moralkanda lies at 31°15′ N and 77°45′ E and falls outside the boundary of the area covered by Collett's (1902)[4] flora simlensis. The specimens enumerated in the list are lodged in the herbarium of the National Botanic Gardens, Lucknow.

Location and topography

Moralkanda hill tract lies at 31°15′ N and 77°54′ E in the Rohru and Rampur Tehsils of Simla District in Himachal Pradesh. The main hill range starts from Sungri and extends to a place called Chander Nahan, the origin of the river Pabbar. This hill range forms the dividing line between the catchments of Sutlej and Pabbar rivers. Regular transport is available from Simla to Khudrala (90 km); from there onwards up to Sungri, there is a fair-weather motorable road (15 km).

The entire tract is mountainous with elevations ranging between 2100 m and 5500 m above mean sea level. However, the expanses of the slopes extend down into the valleys even to lower altitudes. The slopes are generally moderate to steep. The undulating meadows serve as good grazing pastures for sheep and goats.

Geology soil and climate:

The rocks consist of mainly gneiss and micaceous schist, often interspersed with outcrops of granite.

The soil varies from loam to sandy-loam.

The area receives a total of 100-150 cm rainfall annually. The maximum temperature remains around 10°C and minimum goes below freezing point (–5°C).

Vegetation:

When approached from Sungri, the lower hill slopes of the tract up to around 2700 m are covered with conifers like *Cedrus deodara, Picea smithiana, Pinus wallichiana, Abies pindrow* and *Taxus wallichiana.* The prominent broad leaved trees are *Acer caudatum, Prunus cornuta* and *Rhododendron arboreum.* The noteworthy woody climbers are *Clematis connata, Schisandra grandiflora, Hedera nepalensis* and *Parthenocissus semicordata.* Among shrubs or small trees mention may be made

[1] Accepted July 1973.

[2], [3] On the staff of Amalgamated Units, Central Council for Research in Indian Medicine and Homoeopathy.

[4] Collett, H. (1902): Flora Simlensis (second impression 1921). London.

of *Norysca urala, Coriaria nepalensis, Desmodium tiliaefolium, Indigofera heterantha, Prinsepia utilis, Rubus* sp., *Rosa sericea, Spiraea lindleyana, S. canescens, Deutzia staminea, Lonicera obovata, Viburnum mullaha, Cynanchum vincetoxicum, Plectranthus japonicus, Sarcococca saligna, Salix elegans* and *Smilax vaginata.* The herbaceous elements as seen at the fringes of arboreal vegetation or on clearings or alongwith the shrubs are *Anemone rivularis, Delphinium vestitum, Thalictrum reniforme, Erysimum hieracifolium, Viola canescens, Lychnis fimbriata, Geranium wallichianum, Oxalis corniculata, Impatiens scabrida, Agrimonia pilosa* var. *nepalensis, Potentilla nepalensis, Astilbe rivularis, Bergenia ligulata, Sedum crassipes, Circaea cordata, C. imaicola, Epilobium brevifolium, Bupleurum falcatum, Pimpinella diversifolia, Galium mollugo* ssp. *asperifolium, Ainsliaea aperta, Anaphalis busua, A. contorta, A. margaritacea* ssp. *angustior, Aster peduncularis* ssp. *peduncularis, Carpesium pubescens, Prenanthes brunoniana, Senecio chrysanthemoides, S. rufinervis, Taraxacum officinale, Androsace lanuginosa, Swertia tetragona, S. purpurascens, Cynoglossum lanceolatum, Pedicularis megalantha, Wulfenia amherstiana, Clinopodium vulgare, C. umbrosa, Elsholtzia patrini, Leonurus cardiaca, Nepeta elliptica, N. ciliaris, Origanum vulgare, Phlomis bracteosa, Prunella vulgaris, Salvia nubicola, Thymus serpyllum, Plantago erosa, Achyranthes bidentata, Cyathula capitata, Chenopodium album, Polygonum aviculare, P. amplexicaule* var. *speciosa, P. alatum, P. polystachyum, Cannabis sativa, Lecanthus wightii, Urtica parviflora, Epipactis latifolia.*

Reaching higher up to around 3500 m, trees and shrubs frequently met with are *Pyrus lanata, Betula utilis, Berberis lycium, B. chitria, Euonymus fimbriatus, Cotoneaster acuminatus, Rosa macrophylla, R. sericea, Spiraea vestita, Sorbus foliolosa, Ribes rubrum, Lonicera myrtillus* var. *depressa, Viburnum cotinifolium, V. erubescens, Rhododendron lepidotum, Jasminum revolutum* and *Pteracanthus alatus.* The commoner herbs collected at higher altitudes include *Anemone obtusiloba, Thalictrum cultratum, Corydalis moorcroftiana, Trifolium repens, Sibbaldia parviflora, Bergenia stracheyi, Saxifraga diversifolia* var. *parnassifolia, Sedum crassipes, Selinum wallichianum, Rubia manjith, Valeriana hardwickii, Morina longifolia, Artemisia nilagirica, Erigeron multiradiatus, Prenanthes violaefolia, Scrophularia calycina, Verbascum thapsus, Nepeta govaniana, Prunella vulgaris, Stachys sericea* and *Rumex nepalensis.*

It may be noted that many of the herbs encountered at the lower altitudes continue to ascend to the higher regions whereas the ones mentioned in higher altitudinal zones may descend to lower levels. Among the most important tree elements that one encountered between 2400 m and 3500 m mention may be made of *Quercus semecarpifolia.* At around 3500 m pure formations of this species are a notable feature. At several places this species alongwith *Viburnum erubescens* form the last tree line. At still higher altitudes, there are green meadows where vegetation is composed of herbs or procumbent shrubs such as *Aconitum heterophyllum, Geranium collinum, Astragalus himalayanus, Acomastylis elata, Cotoneaster microphylla, Parnassia nubicola, Saxifraga diversifolia, Epilobium laxum, Bupleurum wightianum, Selinum vaginatum, Anaphalis royleana, Artemisia nilagirica, Tanacetum longifolium, Taraxacum officinale, Cyananthus lobatus, Pedicularis brunoniana, P. megalantha, Stachys sericea, Iris* sp., alongwith several of the species that are met with at around 3000-3500 m.

A total of 219 specific or infraspecific taxa was collected from the Moralkanda region in the months of September and October. Of these 188 were dicotyledons, 17 monocotyledons, 5 gymnosperms and 9 pteridophytes. The specimens enumerated in the list are lodged in the herbarium of National Botanic Gardens, Lucknow.

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ANGIOSPERM

RANUNCULACEAE

Aconitum heterophyllum Wall. ex Royle
A perennial erect herb having dull green-blue flowers with purple veins.
3660 m. Fruiting. Frequent. *Sharma & Badola 944.*

Anemone obtusiloba D. Don
A perennial herb with white flowers or flowers tinged with blue near the base.
2810 m. Flowering, petals white inside, purple outside. Occasional. *Sharma & Badola 894*; 3355 m. Flowering, flowers white or violet. Frequent at this altitude. *Sharma & Badola 985.*

A. rivularis Buch.-Ham. ex DC.
A perennial herb with flowers white inside and bluish outside.
2745 m. Fruiting, fruit hooked. Common. *Sharma & Badola 869.*

Clematis connata DC.
A woody, climbing shrub with yellow-white flowers.
2590 m. Flowering. Frequent. *Sharma & Badola 795.*

Delphinium vestitum Wall.
An erect herb with dull blue flowers.
2745 m. Flowering. Frequent. *Sharma & Badola 871.*

Ranunculus hirtellus Royle
A perennial herb with bright yellow flowers.
3355 m. Flowering, flowers yellow. Occasional. *Sharma & Badola 979.*

Thalictrum cultratum Wall.
A perennial, glabrous herb with white flowers.
3050 m. Fruiting. Frequent. *Sharma & Badola 934.*

T. foliolosum DC.
A tall perennial herb with white-pale-green flowers.
2290 m. Fruiting, 5-6 fruits per head. Frequent at this altitude. *Sharma & Badola 1016.*

T. reniforme Wall.
A perennial herb with large leaves and greenish-white flowers.
2810 m. Fruiting. Common. *Sharma & Badola 895.*

SCHISANDRACEAE

Schisandra grandiflora Hook. f. & Thoms.
A woody, glabrous, climbing shrub with pinky-white flowers.
2745 m. Vegetative. Occasional, climbing on trees. *Sharma & Badola 892.*

BERBERIDACEAE

Berberis chitria Ham. ex Ker. (*B. umbellata* Wall. ex Hook. f. et Thomson)

An erect, straggling shrub with yellow flowers.
3200 m. Fruiting. Frequent. *Sharma & Badola 947.*

B. lycium Royle
An erect, woody, yellow shrub with pale yellow flowers.
2895 m. Fruiting. Occasional. *Sharma & Badola 870.*

FUMARIACEAE

Corydalis cornuta Royle
A procumbent, glaucous herb with yellow flowers tipped with dark purple.
2745 m. Flowering and fruiting, flowers yellow, tongue dark purple. Occasional. *Sharma & Badola 887.*

C. moorcroftiana Wall. ex Hook. f. & T.
A herb with woody root stock and flowers yellow with purple tips.
3395 m. Flowering and fruiting, flowers yellow, tongue dark violet. Frequent at this altitude at moist places. *Sharma & Badola 981.*

BRASSICACEAE (CRUCIFERAE)

Capsella bursa-pastoris (Linn.) Medic.
An erect, annual herb covered with branched hairs; flowers small, white.
3050 m. Flowering and fruiting, flowers white. Occasional. *Sharma & Badola 933.*

Erysimum hieracifolium Linn.
A perennial herb, covered with short, adpressed, forked, stellate and simple, hairs; flowers orange-yellow.
2745 m. Flowering and fruiting, flowers yellow. Frequent. *Sharma & Badola 873.*

VIOLACEAE

Viola canescens Wall.
A softly pubescent herb with lilac flowers.
2590 m. Flowering and fruiting, flowers bluish or pinkish. *Sharma & Badola 814.*

V. inconspicua Blume (*V. patrinii* DC.)
A glabrous or pubescent herb with dark lilac flowers.
2895 m. In bud. Rare. *Sharma & Badola 877.*

CARYOPHYLLACEAE

Lychnis fimbriata Wall. ex Benth. (*L. indica* Benth. var. *fimbriata* (Wall. ex Benth.) Edgew. & Hk. f.
A tall dichotomously branched, perennial, pubescent herb with purple or cream-white flowers.
2590 m. Flowering and fruiting. Flowers cream coloured with bluish-tinge. Frequent. *Sharma & Badola 810.*

HYPERICACEAE

Hypericum elodeoides Choisy
A perennial herb with yellow flowers.
2745 m. Flowering and fruiting, flowers yellow. Occasional. *Sharma & Badola 927.*

Norysca urala (Hamilt.) K. Koch (*Hypericum patulum* Thunb.)
A glabrous shrub with yellow flowers.
2590 m. Fruiting, small shrub on dry rocks. *Sharma & Badola 812.*

GERANIACEAE

Geranium collinum Steph. ex Willd.
9 diffuse or ascending, hoary or glandular-pubescent herb with 5-7-lobed orbicular leaves.
3660 m. Flowering, flowers purple. Common at this altitude. *Sharma & Badola 966.*

G. nepalense Sweet
A slender, much branched, diffuse, hairy herb with pale purple flowers.

2590 m. Flowering and fruiting, flowers small, pinkish or bluish with blue streaks. *Sharma & Badola 816.*

G. wallichianum D. Don ex Sweet
An erect, perennial, hairy herb with blue-purple flowers.
2590 m. Flowering, flowers blue and large. Abundant. *Sharma & Badola 845.*

OXALIDACEAE

Oxalis corniculata Linn.
A diffuse, creeping annual with yellow flowers.
2590 m. Flowering and fruiting, flowers yellow. Frequent. *Sharma & Badola 820.*

BALSAMINACEAE

Impatiens amphorata Edgew.
A glabrous, branched herb with purple flowers.
2290 m. Flowering and fruiting, flowers pinkish. Frequent. *Sharma & Badola 1003.*

I. micranthemum Edgew.
A glabrous herb with white flowers; the lip spotted with pink and yellow.
2290 m. Flowering and fruiting, flowers small, white. Frequent. *Sharma & Badola 1006.*

I. scabrida DC.
An erect, pubescent herb with golden yellow flowers.
2590 m. Flowering and fruiting, flowers yellow, large. Common. *Sharma & Badola 806.*

I. thomsoni Hook. f.
A tall, glabrous herb with pale-pink flowers.
3355 m. Flowering and fruiting, flowers blue. Occasional. *Sharma & Badola 977.*

RUTACEAE

Boenninghausenia albiflora Reichb.
A perennial, nearly glabrous herb with white flowers.
2290 m. Flowering and fruiting, flowers white. Rare. *Sharma & Badola 1015.*

CELASTRACEAE

Euonymus fimbriatus Wall.
A tree with white flowers.
2835 m. Fruiting, fruits 3-4 angular and 3-4-seeded capsule. Small tree. Occasional. *Sharma & Badola 889.*

E. tingens Wall.
A small tree with yellowish white flowers.
2290 m. Fruiting, small shrub growing on dry rock. Rare. *Sharma & Badola 1005.*

VITACEAE

Parthenocissus semicordata (Wall.) Planch. (*Vitis himalayana* Brandis var. *semicordata* Lawson)
An extensive climbing shrub with yellow-green flowers.
2745 m. Fruiting. Frequent. *Sharma & Badola 884.*

ACERACEAE

Acer caudatum Wall.
A large tree with glaucous shoots and white flowers.
2745 m. Vegetative. Frequent. *Sharma & Badola 898.*

ANACARDIACEAE

Rhus punjabensis Stewart
A tree, with white or pale yellow-green flowers.
2135 m. Vegetative, small tree. Occasional. *Sharma & Badola 1022.*

Coriariaceae

Coriaria nepalensis Wall.
A large, glabrous shrub with small greenish yellow flowers.
2590 m. Vegetative. Occasional. *Sharma & Badola 792.*

Fabaceae (Papilionaceae)

Astragalus himalayanus Klotzsch
A perennial herb, with lilac or purple flowers.
3660 m. Fruiting. Common, procumbent herb. *Sharma & Badola 969.*

Caragana brevispina Royle
An erect, shrub with bright yellow flowers.
2290 m. Fruiting, large shrub. Frequent. *Sharma & Badola 1017.*

Desmodium tiliaefolium G. Don
A tall erect shrub with pale pink flowers.
2590 m. Flowering. Frequent. *Sharma & Badola 786.*

Indigofera habepetala Benth.
A tall, thinly hairy or glabrous shrub with crimson-red flowers.
2290 m. Fruiting, large shrub. Frequent at this altitude. *Sharma & Badola 1004.*

I. heterantha Wall. ex Brandis (*I. gerardiana* Wall. ex Baker)
A silvery pubescent or tomentose shrub with pale red or purple flowers.
2590 m. Flowering and fruiting, flowers purple. Frequent. *Sharma & Badola 836.*

Parochetus communis Buch.-Ham. ex D. Don
A slender, creeping, hairy herb with deep violet-blue flowers.
2440 m. Flowering and fruiting, flowers blue. Slender herb, creeping on moist soil. *Sharma & Badola 992.*

Trifolium repens Linn.
A glabrous or slightly hairy, perennial herb. Flowers white or tinged with pink.
3050 m. Flowering, flowers white. Stem creeping on ground. Common. *Sharma & Badola 847.*

Vicia pallida Turez.
A tall, straggling, glabrous climber with pale lilac flowers.
2590 m. Flowering and fruiting, flowers white-purple. Creeping on rocks. Occasional. *Sharma & Badola 809.*

Rosaceae

Acomastylis elata (Wall.) F. Bolle (*Geum elatum* Wall.)
A soft, hairy herb; root stock perennial; flowers yellow.
3660 m. Flowering and fruiting, flowers yellow, large. Common at this altitude. *Sharma & Badola 964.*

Agrimonia pilosa Ledeb. var. *nepalensis* (D. Don) Nakai (*A. eupatorium* Linn.)
A perennial, hairy herb with yellow flowers.
2590 m. Flowering and fruiting, flowers yellow. Frequent. *Sharma & Badola 807.*

Cotoneaster acuminatus Lindl.
2895 m. Fruiting. Large shrub. Frequent. *Sharma & Badola 885.*

C. affinis Lindl. var. *bacillaris* (Lindl.) Schneid.
A large slender shrub with white flowers.
2290 m. Vegetative, small tree. Frequent. *Sharma & Badola 999.*

C. microphylla Wall. ex Lindl.
A dwarf, dense, usually procumbent, much branched shrub with white flowers.
3660 m. Fruiting. Bush. Frequent. *Sharma & Badola 958.*

Geum urbanum Linn.
A softly hairy herb with pale yellow flowers.

2290 m. Fruiting. Rare. *Sharma & Badola 997.*

Potentilla arbuscula D. Don (*P. fruticosa* auct non Linn.)
An erect or prostrate herb with bright yellow flowers.
3355 m. Vegetative shrub. Occasional. *Sharma & Badola 955.*

P. nepalensis Hook. f.
A perennial herb with dark crimson flowers.
2590 m. Flowering, flowers red. Frequent. *Sharma & Badola 791.*

Prinsepia utilis Royle
A dark green, glabrous, spiny shrub with white flowers.
2590 m. Flowers in bud. Frequent. *Sharma & Badola 817.*

Prunus cornuta (Royle) Steud.
A moderate-sized tree with white flowers.
2440 m. Vegetative. Frequent. *Sharma & Badola 995.*

Pyrus lanata Don
A tree, more or less white-tomentose, with white flowers.
3050 m. Fruiting, berry many seeded, of the size of that of *Ficus glomerata*, seeds black. Fruits eaten by local people. A small tree. Frequent. *Sharma & Badola 856.*

P. pashia Buch.-Ham. ex D. Don
A small, deciduous tree, flowers white, tinged with pink.
2290 m. Vegetative. Occasional. *Sharma & Badola 1021.*

Rosa macrophylla Lindl.
An erect, prickly shrub with pink flowers.
3355 m. Fruiting, fruits large, red. Occasional. *Sharma & Badola 937.*

R. moschata Mill. ex J. Herrmann
A tall climbing, glabrous or nearly so, prickly shrub with white flowers.
2290 m. Fruiting. Occasional. *Sharma & Badola 1001.*

R. sericea Lindl.
An erect, pubescent, sometimes glandular, prickly or smooth shrub with white flowers.
2895 m. Vegetative, branches spinous or without spines. Frequent at this altitude. *Sharma & Badola 886;* 2795 m. Vegetative. Frequent. *Sharma & Badola 903.*

Rubus sp.
A prickly shrub.
2950 m. *Sharma & Badola 794.*

Sibbaldia parviflora Willd.
A small-flowered plant covered with rather stiff silky hairs.
3355 m. Fruiting. Frequent at this altitude. *Sharma & Badola 978.*

Sorbus foliolosa (Wall.) Spach (*Pyrus foliolosa* Wall.)
A shrub or small tree; leaves and inflorescence more or less covered with red-brown tomentum; flowers white or tinged with green.
3510 m. Fruiting, fruits pinkish. Small tree, leaves imparipinnate, leaflets usually 15-23. Occasional. *Sharma & Badola 943.*

Spiraea canescens D. Don
A small, stiff, softly tomentose or pubescent shrub with white or pale pink flowers.
2590 m. Fruiting. Frequent. *Sharma & Badola 793.*

S. lindleyana Wall. (*S. sorbifolia* Linn.)
A tall, nearly glabrous shrub with white flowers.
2440 m. Fruiting. Frequent at this altitude. *Sharma & Badola 1002.*

S. vestita Wall.
A shrub-like herb; root stock perennial. Flowers white.

3355 m. Fruiting. Occasional. *Sharma & Badola 951.*

SAXIFRAGACEAE

Astilbe rivularis Buch.-Ham. ex D. Don
An erect, hairy perennial herb with very small green-yellow flowers.
2810 m. Fruiting. Frequent. *Sharma & Badola 893.*

Bergenia ligulata (Wall.) Engl.
A perennial herb with thick root stock; flowers white, pink or purple.
2590 m. Vegetative. Frequent. *Sharma & Badola 822.*

B. stracheyii (Hook. f. & Thoms.) Engl.
A perennial herb with a stout woody rootstock; flowers white or rose.
3355 m. Fruiting. Common on wet rocks at this altitude. *Sharma & Badola 976.*

Parnassia nubicola Wall. ex Royle
A glabrous, perennial herb; root stock stout; flowers white.
3660 m. Fruiting. Frequent. *Sharma & Badola 945.*

Ribes rubrum Linn.
An erect, pubescent or nearly glabrous shrub with green-yellow flowers.
3050 m. Fruiting, fruits black. Frequent. *Sharma & Badola 932.*

Saxifraga diversifolia Wall. ex Sternb.
An erect herb with yellow or pale yellow flowers.
3660 m. Flowering and fruiting, flowers yellow. Frequent around this altitude. *Sharma & Badola 980.*

S. diversifolia Wall. ex Sternb. var. *parnassifolia* (D. Don) Engl.
An erect herb with yellow flowers.
3355 m. Flowering, flowers yellow. Frequent at this altitude. *Sharma & Badola 974.*

HYDRANGEACEAE

Deutzia staminea R. Br. ex Wall.
An erect, stellately pubescent shrub with white flowers.
2590 m. Fruiting. Occasional. *Sharma & Badola 832.*

Philadelphus tomentosus Wall. ex Royle (*P. coronarius* Linn.)
An erect shrub, nearly or quite glabrous with orange-white flowers.
2290 m. Fruiting. Rare. *Sharma & Badola 1007.*

CRASSULACEAE

Sedum crassipes Wall. ex Hook. f. & Thoms. (*S. asiaticum* Cl. non DC.)
A succulent herb with yellow flowers.
3355 m. Fruiting. Occasionally abundant. *Sharma & Badola 952.*

S. linearifolium Royle (*S. trifidum* Wall.)
An erect, glabrous herb with pale pink flowers.
2745 m. Fruiting. Occasional, growing on tree trunk. *Sharma & Badola 909.*

ONAGRACEAE

Circaea cordata Royle
An erect, pubescent or hairy herb with white flowers.
2590 m. Fruiting. *Sharma & Badola 797.*

C. imaicola (Asch. et Magn.) Hand.-Maz. (*C. alpina* Clarke non Linn.)
An erect, glabrous or slightly pubescent herb; flowers white tinged with pink.
2745 m. Flowering and fruiting, flowers white, minute. Common. *Sharma & Badola 928.*

Epilobium brevifolium D. Don
A pubescent herb with purple pink flowers.
2745 m. Flowering and fruiting, flowers pink-purple. Frequent. *Sharma & Badola 901.*

E. laxum Royle
A herb with hairy stem.
3660 m. Fruiting. Common. *Sharma & Badola 954.*

Oenothera rosea Aiton
A small herb with purple flowers.
2895 m. Flowering and fruiting, flowers purple. Rare. *Sharma & Badola 866.*

Apiaceae (Umbelliferae)

Bupleurum candolii Wall. ex DC.
An erect glabrous herb with yellow flowers.
2290 m. Fruiting. Occasional. *Sharma & Badola 998.*

B. falcatum Linn.
An erect, glabrous herb with yellow flowers.
2590 m. Flowering and fruiting. Frequent. *Sharma & Badola 833.*

B. wightianum P. K. Mukerjee (*B. mucronatum* Wt.)
An erect herb with yellowish flowers.
3660 m. Fruiting. Common at this altitude. *Sharma & Badola 962.*

Chaerophyllum villosum Wall. ex DC.
A large herb with white flowers.
3355 m. Flowering and fruiting, flowers white. Occasional. *Sharma & Badola 940.*

Pimpinella diversifolia DC.
An erect hairy or pubescent herb with white flowers.
2590 m. Flowering and fruiting, flowers white. *Sharma & Badola 821;* 2895 m. Frequent. *Sharma & Badola 865.*

Pleurospermum brunonis Benth.
An erect herb with minute, purple flowers.
3355 m. Fruiting. Occasional. *Sharma & Badola 936.*

Selinum vaginatum C.B. Clarke
A glabrous, perennial herb with white flowers.
3660 m. Flowering and fruiting. Frequent. *Sharma & Badola 949.*

S. wallichianum (DC.) Raizada & Saxena (*S. tenuifolium* Wall. ex DC.)
A glabrous perennial herb with white flowers.
3355 m. Fruiting. Frequent. *Sharma & Badola 935.*

Araliaceae

Hedera nepalensis K. Koch (*H. helix* auct non Linn.)
A large evergreen woody climber with yellowish green flowers.
2290 m. In buds and fruiting. Frequent on trees. *Sharma & Badola 1014.*

Caprifoliaceae

Lonicera myrtillus var. *depressa* Rehder (*L. parvifolia* Edgew.)
A small, rigid nearly glabrous shrub with small white, pink tinged flowers, branches often prostrate.
3355 m. Vegetative. Occasional. *Sharma & Badola 946.*

L. obovata Royle ex Hook. f. & Thomson
A glabrous shrub; flowers white, fading to yellow.
2745 m. Vegetative. Frequent. *Sharma & Badola 920.*

Viburnum cotinifolium D. Don
A large deciduous shrub; flowers white or tinged with pink.
3050 m. Fruiting, fruits black. Frequent at this altitude. *Sharma & Badola 858.*

V. erubescens Wall.
A large shrub, or small tree with white flowers.
3510 m. Fruiting, mature fruits black. Frequent in oak forest to the end of tree line. *Sharma & Badola 948.*

V. mullaha Buch.-Ham. ex D. Don (*V. stellulatum* Wall.)
An erect shrub or small tree with white flowers.
2810 m. Fruiting, fruits red. Frequent. *Sharma & Badola 890.*

RUBIACEAE

Galium mollugo Linn. ssp. *asperifolium* (Wall.) Kitamura (*G. asperifolium* Wall.)
A perennial, slender herb with red flowers.
2590 m. Flowering and fruiting. Common. *Sharma & Badola 842.*

Rubia manjith Roxb. ex Fleming (*R. cordifolia* L.)
A climbing perennial herb with small dark red flowers.
2895 m. Vegetative. Frequent. *Sharma & Badola 881.*

VALERIANACEAE

Valeriana hardwickii Wall.
A pubescent annual herb with white flowers.
3355 m. Flowering and fruiting. Frequent. *Sharma & Badola 986.*

DIPSACACEAE

Dipsacus mitis D. Don (*D. inermis* Wall.)
An erect herb with white or yellowish flowers.
2745 m. Flowering and fruiting, flowers white. Occasional. *Sharma & Badola 883.*

Morina longifolia Wall. ex DC.
An erect, perennial herb with pink flowers.
2990 m. Flowering and fruiting, flowers white. Common at this altitude in open places. *Sharma & Badola 860.*

ASTERACEAE (COMPOSITAE)

Achillea millefolium Linn.
An erect, pubescent herb with white or pale pink flowers.
2745 m. Flowering, flowers white. Occasional. *Sharma & Badola 874.*

Ainsliaea aptera DC.
An erect slender rather robust herb. Heads in interrupted spikes or spreading branched panicles, achenes obscurely ribbed.
2590 m. In buds. Common. *Sharma & Badola 819.*

Anaphalis busua (Buch.-Ham.) Hand.-Mazz. (*A. araneosa* DC.)
An erect herb; heads sub-globose in subglobose clusters or in large, open, much branched corymbs, invol. bracts elliptic, obtuse, white, opaque.
2590 m. Flowering, ray florets whitish, disc florets pale yellow. *Sharma & Badola 811.*

A. contorta Hook. f.
An erect herb with white or yellowish heads.
2590 m. Flowering. Common. *Sharma & Badola 824.*

A. margaritacea Benth. ex Hook. f. ssp. *angustior* Kitamura (*A. cinnamomea* C.B. Clarke)
An erect herb; heads subglobose, many invol. bracts, elliptic, ovate, obtuse, erect or incurved, white, opaque.
2590 m. Flowering. Leaves on lower surface woolly and white. Common. *Sharma & Badola 844.*

A. royleana DC.
An erect herb; heads in rounded corymbs,

invol. bracts ovate, obtuse or acute, white. 3660 m. Flowering. Common. *Sharma & Badola 983.*

Artemisia nilagirica (Clarke) Pamp. (*A. vulgaris* auct non Linn.)
An erect tomentose, shrub like herb with dull white flowers.
3050 m. Fruiting. Common at this altitude in open places. *Sharma & Badola 864;* 3660 m. Fruiting. Lower surface of leaf silky white. Abundant at this altitude. *Sharma & Badola 972.*

A. roxburghiana Besser (*A. hypoleuca* Edgew.)
A shrub like herb with purple heads.
2590 m. Flowering. Leaves white silky on lower side. Occasional. *Sharma & Badola 818.*

Artemisia sp.
3050 m. Vegetative. Common at this altitude in open areas. *Sharma & Badola 855.*

Aster peduncularis Wall. ex Nees ssp. *peduncularis* (*A. asperulus* Nees)
An erect, branched, nearly glabrous herb with purple flower heads.
2590 m. Flowering, flowers bluish. Common. *Sharma & Badola 804.*

Carpesium pubescens Wall. ex DC. (*C. cernuum* Linn.)
An erect, branched, pubescent herb with yellow heads.
2745 m. Flowering. Frequent. *Sharma & Badola 897.*

Cicerbita macrorhiza (Royle) Beauv. var. *sexatilis* Beauv. (*Lactuca macrorhiza* Hook. f.)
A glabrous herb with grey blue heads.
3355 m. Flowering, flowers purple-violet. Procumbent herb, growing in moist places. Occasional. *Sharma & Badola 982.*

Cirsium wallichii DC. (*Cnicus wallichii* DC.)
An erect, pubescent herb with dull yellow heads.
2440 m. Fruiting. Frequent. *Sharma & Badola 996.*

Erigeron canadensis Linn.
An annual herb with numerous small yellow heads.
2290 m. Flowering. Occasional. *Sharma & Badola 1024.*

E. multiradiatus (Wall.) Benth. & Hook. f.
An erect hairy herb with dark purple heads.
2895 m. Flowering, ray florets violet, disc florets yellowish. Frequent. *Sharma & Badola 876.*

Myriactis wallichii Less.
An erect, pubescent herb with white ray-flowers and yellow disc-flowers turning dull purple in fruit.
2590 m. Flowering and fruiting, flowers pinkish. *Sharma & Badola 841.*

Prenanthes brunoniana Wall.
An erect herb with white or purple heads.
2590 m. Flowering. Frequent. *Sharma & Badola 829;* 2290 m. Flowering. Frequent. *Sharma & Badola 1011.*

P. violaefolia Dcne.
An erect, glabrous herb with purple heads.
3510 m. Flowering, flowers blue. Frequent. *Sharma & Badola 965.*

Senecio chrysanthemoides DC.
An erect, herb, glabrous towards the base, pubescent upwards, heads bright yellow.
2745 m. Flowering, flowers yellow. Frequent. *Sharma & Badola 929.*

S. kunthianus Wall.
An erect herb. Leaves ash-white underneath. Heads yellow, involucre black.
3355 m. Flowering and fruiting, flowers yellow. Occasional. *Sharma & Badola 963.*

S. rufinervis DC.
A tall shrub like herb, branches, stem and inflorescence tomentose.
2590 m. Flowering, flowers yellow. Frequent. *Sharma & Badola 800.*

Siegesbeckia orientalis Linn.
An erect herb, clothed with crisped hairs; heads yellow, sometimes white.
2745 m. Flowering and fruiting, flowers yellow. Occasional. *Sharma & Badola 926.*

Solidago virga-aurea Linn.
An erect, pubescent herb with yellow heads.
3050 m. Flowering, flowers yellow. Rare. *Sharma & Badola 857.*

Tagetes minuta Linn.
An erect herb with pale yellow heads.
2135 m. Flowering. A few plants seen at this altitude. *Sharma & Badola 1019.*

Tanacetum longifolium Wall. ex DC.
An erect strong-scented hairy herb with bright yellow heads.
3660 m. Flowering, flowers yellow. Common at this altitude. *Sharma & Badola 953.*

Taraxacum officinale Weber
A perennial herb with milky juice with yellow heads.
2745 m. Flowering, flowers yellow. Common. *Sharma & Badola 849;* 3660 m. Common. *Sharma & Badola 970.*

Xanthium strumarium Linn.
An erect, coarse, rough herb.
2135 m. Flowering. A few plants seen at the spot. *Sharma & Badola 1023.*

CAMPANULACEAE

Campanula colorata Wall. (*C. ramulosa* Wall.)
A roughly hairy herb with pale lilac, purple or grey purple flowers.
2590 m. Flowering and fruiting, flowers violet. Plant hairy. *Sharma & Badola 815.*

Cyananthus lobatus Wall. ex Benth.
A small herb with dark blue flowers.
3660 m. Flowering and fruiting; flowers violet, calyx hairy, persistent. Common at this altitude. *Sharma & Badola 971.*

ERICACEAE

Rhododendron arboreum Smith
A tree with red or pink flowers.
2590 m. Vegetative. Occasional. *Sharma & Badola 840.*

R. lepidotum Wall.
An erect, aromatic shrub with dingy yellow or pale pink-purple flowers.
3355 m. Fruiting. Frequent at this altitude. *Sharma & Badola 959.*

PRIMULACEAE

Androsace lanuginosa Wall. ex Roxb.
A small herb, covered with silvery white silky hairs; flowers pale or dark-purple, tinged with blue, centre yellow.
2745 m. Vegetative. Common. *Sharma & Badola 917.*

OLEACEAE

Jasminum revolutum Sims. (*J. humile* Linn.)
An erect, glabrous shrub with yellow flowers.
2990 m. Fruiting. Frequent. *Sharma & Badola 861.*

ASCLEPIADACEAE

Cynanchum vincetoxicum (Linn.) Pers.
An erect, pubescent shrub with small yellow flowers.
2745 m. Fruiting. Occasional. *Sharma & Badola 908.*

Gentianaceae

Swertia cordata Wall. ex Clarke
An erect herb. Corolla yellow white, margins marked with short, pale purple streaks.
2745 m. Flowering and fruiting, flowers cream coloured, an orange gland present at the base of each petal. Occasional. *Sharma & Badola 851.*

S. purpurascens Wall. ex Clarke
An erect herb, branches spreading. Corolla pale red-purple with a dark single complete ring at the base.
2745 m. Flowering, petals dark purple at base. Frequent. *Sharma & Badola 915.*

S. speciosa Wall. ex Griseb.
An erect herb with lurid grey flowers.
3355 m. Flowering and fruiting. Occasional. *Sharma & Badola 957.*

S. tetragona Edgew.
An erect herb with white flowers.
2440 m. Flowering, flowers white, petals not purple, at the base. Rare. *Sharma & Badola 989.*

Boraginaceae

Cynoglossum lanceolatum Forsk.
An erect herb; corolla pale blue or white.
2745 m. Flowering and fruiting, flowers deep violet. Frequent. *Sharma & Badola 900.*

C. microglochin Benth.
An erect, softly pubescent, herb with dark blue flowers.
3510 m. Fruiting, occasional, *Sharma & Badola 939B;* 3355 m. Flowering, flowers deep violet. Occasional. *Sharma & Badola 960.*

Hackelia uncinata (Royle ex Benth.) C.E.C. Fischer (*H. glochidiata* Brand.)
Herb, flowers blue with yellow centre.
3510 m. Fruiting. Occasional. *Sharma & Badola 939 A.*

Solanaceae

Datura stramonium Linn.
An annual, erect, nearly glabrous herb with white flowers.
2135 m. Flowering and fruiting. Occasional. *Sharma & Badola 987.*

Scrophulariaceae

Mazus pumilus (Burm. f.) Steenis [*M. japonicus* (Thunb.) O. Kuntze; *M. rugosus* Lour.]
An erect, small, glabrous herb with pale blue or white flowers.
2135 m. Flowering and fruiting. Common. *Sharma & Badola 1025.*

Pedicularis brunoniana Wall. ex Pennell (*P. gracilis* Wall. ex Benth.)
An erect herb with pink purple flowers.
2745 m. Flowering and fruiting, flowers purple. Frequent. *Sharma & Badola 880;* 3660 m. Fruiting. Common. *Sharma & Badola 967.*

P. megalantha D. Don
An erect, pubescent herb with bright yellow flowers.
2620 m. Flowering and fruiting, flowers yellow. Frequent. *Sharma & Badola 853;* 3660 m. Fruiting. Common. *Sharma & Badola 938.*

Scrophularia calycina Benth.
A herb, glabrous or sparsely pubescent above; flowers greenish-purple or yellow.
3510 m. Fruiting. Frequent at this altitude. *Sharma & Badola 942.*

S. himalensis Royle ex Benth.
An erect herb with greenish flowers.
3355 m. Fruiting. Occasional. *Sharma & Badola 941*

Verbascum thapsus Linn.
An erect herb densely clothed with soft, yellow-grey, stellate hairs. Flowers yellow. 2895 m. Flowering and fruiting. Frequent. *Sharma & Badola 875.*

Wulfenia amherstiana (Wall.) Benth.
A nearly glabrous, perennial herb; flowers drooping, blue-purple varying to white. 2745 m. Fruiting. Common small herb. *Sharma & Badola 907.*

Acanthaceae

Pteracanthus alatus (Wall. ex Nees) Bremk. (*Strobilanthes alatus* Nees)
An erect pubescent shrub with dark blue flowers.
3050 m. Flowering and fruiting, flowers violet. Common at this altitude. *Sharma & Badola 863.*

Lamiaceae (Labiatae)

Clinopodium umbrosum (M.B.) C. Koch. (*Calamintha umbrosa* Benth.)
A softly hairy herb with pink or purple flowers.
2590 m. Flowering, flowers blue. Frequent. *Sharma & Badola 843;* 2745 m. Flowering and fruiting. Frequent. *Sharma & Badola 911.*

C. vulgare Linn. (*Calamintha clinopodium* Benth.)
A softly hairy herb with small pink or purple flowers.
2745 m. Flowering and fruiting, flowers bluish. Frequent. *Sharma & Badola 910.*

Elsholtzia patrinii (Lep.) Garcke. (*E. cristata* Willd.)
An erect, pubescent, fragrant herb with purple flowers.
2590 m. Flowering and fruiting, flowers white. Common. *Sharma & Badola 826.*

Lamium album Linn.
A decumbent or ascending, perennial herb with white or pale-pink flowers.
2290 m. Fruiting. Occasional. *Sharma & Badola 1013.*

Leonurus cardiaca Linn.
An erect, pubescent herb with pink flowers. 2745 m. Flowering and fruiting, flowers white, calyx persistent and spiny. Frequent. *Sharma & Badola 872.*

Nepeta ciliaris Benth.
A softly tomentose herb with lilac flowers. 2590 m. Flowering, flowers blue. Frequent. *Sharma & Badola 991.*

N. elliptica Royle ex Benth.
An erect herb with pale blue or nearly white flowers.
2745 m. Flowering, flowers bluish. Frequent. *Sharma & Badola 899.*

N. govaniana Benth.
A tall, erect, branched, finely hairy herb with yellow flowers.
3050 m. Flowering, flowers yellow. Common at this altitude. *Sharma & Badola 862.*

Origanum vulgare Linn.
An erect herb, clothed with short hairs; flowers pink.
2590 m. Flowering and fruiting. Frequent. *Sharma & Badola 830.*

Phlomis bracteosa Royle ex Benth.
An erect, hairy herb with dull blue-purple flowers.
2745 m. Flowering, flowers blue. Frequent. *Sharma & Badola 913.*

Plectranthus japonicus (Burm. f.) Koidz (*P. coetsa* Buch.-Ham. ex D. Don)
An erect, tall, pubescent undershrub with lavender blue flowers.
2590 m. Flowering, flowers purple. Frequent. *Sharma & Badola 831.*

P. rugosus Wall.
A stellately pubescent, herb; flowers white with rose or purple spots.
2135 m. Flowering, flowers white. Frequent at this altitude. *Sharma & Badola 1018.*

Prunella vulgaris Linn. (*Brunella vulgaris* Linn.)
A thinly hairy herb with violet purple flowers.
2745 m. Flowering, flowers violet. Frequent. *Sharma & Badola 924.*

Salvia nubicola Sweet (*S. glutinosa* Linn.)
An erect, perennial, viscidly hairy herb with yellow flowers, having upper lip purple dotted.
2590 m. Flowering, flowers pale yellow. Common. *Sharma & Badola 823.*

Stachys sericea Wall.
An erect herb, covered with long silky hairs; flowers pink, spotted with purple.
3050 m. Flowering, flowers pinkish. Frequent. *Sharma & Badola 859;* 3355 m. Flowering, flowers white or pinkish. Common upto 3660 m in open places. *Sharma & Badola 961.*

Thymus serpyllum Linn.
An aromatic, hairy more or less procumbent, often tufted shrub with small purple flowers.
2745 m. Flowering, flowers pink. Abundant in dry places. *Sharma & Badola 916.*

PLANTAGINACEAE

Plantago erosa Wall. (*P. major* Linn.)
A stemless, perennial herb with numerous green flowers.
2590 m. Fruiting. Common. *Sharma & Badola 805.*

AMARANTHACEAE

Achyranthes bidentata Blume
A straggling, hairy undershrub; spikes greenish, very slender.
2440 m. Fruiting. Frequent. *Sharma & Badola 994.*

Cyathula capitata Moq.
A sparsely hairy herb; heads white, glistening.
2590 m. Flowering. Frequent. *Sharma & Badola 808.*

CHENOPODIACEAE

Chenopodium album Linn.
An erect herb, flower-clusters in axillary spikes, often tinged with purple.
2590 m. Flowering. Frequent. *Sharma & Badola 827.*

C. botrys Linn.
A strongly aromatic, pubescent, glandular herb; flowers small, reddish.
2590 m. Fruiting. Occasional. *Sharma & Badola 802.*

POLYGONACEAE

Fagopyrum cymosum Meissn.
An erect, pubescent herb with white flowers.
2590 m. Flowering and fruiting, flowers white. Occasional. *Sharma & Badola 835.*

Polygonum alatum Buch.-Ham. ex D. Don
An erect herb with white or purple flowers.
2590 m. Flowering, flowers small, pink. Common. *Sharma & Badola 837.*

P. amplexicaule D. Don var. *speciosa* Hook. f.
A nearly glabrous, erect herb; flowers pink or deep red, varying to white.
2745 m. Flowering, flowers red or white. Common. *Sharma & Badola 879.*

P. aviculare Linn.
A very variable, widely spreading, trailing twining plant; flowers small green, tipped with white or red.
2590 m. Flowering. Frequent. *Sharma & Badola 788.*

P. hydropiper Linn.
A 30-45 cm tall herb (prostrate at lower nodes) with pink or red flowers.
2590 m. Flowering. Rare. *Sharma & Badola 990.*

P. polystachyum Wall. ex Meissn.
An erect shrub; flowers white or tinged with pink.
2590 m. Flowering, flowers white. Frequent. *Sharma & Badola 834.*

P. recumbens Royle ex Bab.
A prostrate, rough herb with white or pink flowers.
2590 m. Flowering. Frequent. *Sharma & Badola 787;* 2990 m. Flowering. Procumbent herb. Occasional. *Sharma & Badola 848.*

Rumex nepalensis Spreng.
An erect herb; flowers small, green, often turning red.
2895 m. Fruiting. Common. *Sharma & Badola 852.*

BUXACEAE

Sarcococca saligna (Don) Muell.-Arg.
A handsome, evergreen, glabrous shrub with yellow flowers.
2745 m. Flowering. Frequent undershrub. *Sharma & Badola 912.*

CANNABINACEAE

Cannabis sativa Linn.
A tall erect annual herb with green flowers.
2590 m. Flowering and fruiting. Common. *Sharma & Badola 789.*

URTICACEAE

Girardinia leschenaultiana Decaisne (*G. heterophylla* Decn.)
An erect herb covered with stinging bristles; flowers small, green.
2440 m. Fruiting. Occasional. *Sharma & Badola 1000.*

Lecanthus wightii Wedd.
A succulent, pubescent herb with pink flowers.
2290 m. Flowering. Frequent-common along streams and in damp moist places at this altitude. *Sharma & Badola 1008.*

Parietaria debilis G. Forst.
A diffuse perennial herb; polygamous; male flowers few, female numerous.
2895 m. *Sharma & Badola 867.*

Pilea umbrosa Wedd.
An erect, hairy herb with minute, green flowers.
2290 m. Flowering. Common in damp places at this altitude. *Sharma & Badola 1009.*

Urtica parviflora Roxb.
An erect herb with green flowers.
2680 m. Flowering. Frequent. *Sharma & Badola 854.*

BETULACEAE

Betula utilis D. Don
Tree, bark smooth and paper like, peeling off in thin sheets; male spikes stipitate, female spike stout subsolitary, bracts pubescent.
3355 m. Vegetative. Frequent at this altitude. *Sharma & Badola 984.*

FAGACEAE

Quercus semecarpifolia Smith
A small or large, sub-evergreen, gregarious tree. Male spikes crowded, softly pubescent, female spikes short.

2745 m. Vegetative. Common. *Sharma & Badola 925;* 3510 m. Vegetative. Abundant, limiting the tree-line along with *Viburnum erubescens* Wall. *Sharma & Badola 950.*

Salicaceae

Salix elegans Wall. ex Anders. (*S. kumaonensis* Lindl.)

A shrub or small tree, flowering after leafing. Catkins slender on leafy peduncles, bracts small yellow, male compact, fem. much larger, slender, drooping, bracts minute yellow subpubescent.

2745 m. Fruiting. Occasional. *Sharma & Badola 888.*

Orchidaceae

Epipactis latifolia (Linn.) All.

An erect, terrestrial, leafy herb with dingy purple or green flowers.

2590 m. Fruiting. Frequent. *Sharma & Badola 801.*

Microstylis muscifera Ridley

A terrestrial herb with pale yellow-green flowers.

2745 m. Fruiting. Rare. *Sharma & Badola 905.*

Iridaceae

Iris sp.

3660 m. Vegetative. Common at this altitude. *Sharma & Badola 973.*

Liliaceae

Polygonatum verticillatum Allioni

A herb with creeping root stock and drooping white-green or purple flowers.

3355 m. Vegetative. Occasional. *Sharma & Badola 956;* 3200 m. Fruiting. Occasional. *Sharma & Badola 975.*

Smilacaceae

Smilax vaginata Decaisne

A densely branched, erect shrub with minute, purple flowers.

2745 m. Vegetative. Occasional. *Sharma & Badola 904.*

Commelinaceae

Commelina paludosa Blume

A slender herb with pale blue flowers.

2590 m. Flowering, flowers blue. Rare. *Sharma & Badola 828.*

Araceae

Arisaema helleborifolium Schott.

A tuberous herb with stems mottled with purple; spathe pale green, spadix protruding like a tail.

2290 m. Vegetative. Occasional. *Sharma & Badola 988.*

Cyperaceae

Cyperus aristatus Rottb.

A small, annual herb with numerous, tufted, fibrous roots.

2745 m. *Sharma & Badola 918A.*

Kyllinga squamulata Vahl

A nearly glabrous herb, root fibrous, spikes 1-3, ovoid, nut brown.

2745 m. *Sharma & Badola 918B.*

Poaceae (Gramineae)

Agrostis munroana Aitch. et Hemsl.

An annual erect grass with tufted stems, 15-45 cm tall.

3660 m. Flowering. Abundant. *Sharma & Badola 968.*

A. pilosula Trin. var. *royleana* (Trin.) Bor

An annual erect grass, 30-90 cm tall.

2590 m. Flowering. Frequent. *Sharma & Badola 825.*

Chrysopogon gryllus (Linn.) Trin.
A large coarse grass forming dense, hard tufts.
2590 m. Flowering. 60-90 cm high grass. Frequent. *Sharma & Badola 838.*

Dendrocalamus membranaceus Munro
Arborescent, unarmed.
2745 m. Vegetative. Common. *Sharma & Badola 896.*

Muehlenbergia huegelii Trin. (*M. viridissima* Nees ex Steud.)
Perennial grass, stems tufted, slender, ascending, creeping near the base; panicles drooping.
2590 m. Flowering. Frequent. *Sharma & Badola 796;* 2290 m. Flowering. Common. *Sharma & Badola 1012.*

Pennisetum flaccidum Griseb.
Perennial grass with stems decumbent and creeping near the base.
2590 m. Flowering. Frequent. *Sharma & Badola 839.*

Phacelurus speciosus (Steud.) C. E. Hubb. [*Rottboellia speciosus* (Steud.) Hack.]
An erect perennial, robust, 30-120 cm tall.
2590 m. Flowering. Frequent, tall grass about 60-90 cm high. *Sharma & Badola 803.*

Stipa sibirica (Linn.) Lamk.
An erect, perennial with tufted smooth stems, 30-90 cm tall.
2590 m. Flowering. Frequent. *Sharma & Badola 813.*

GYMNOSPERMS

Taxaceae

Taxus wallichiana Zucc. (*T. baccata* Linn.)
A small or rarely medium sized evergreen tree; plants usually dioecious (male and female flowers rarely on the same tree).
2835 m. Fruiting. Frequent at higher altitude. *Sharma & Badola 902.*

Pinaceae

Abies pindrow Royle [*A. pindrow* (Royle) Spach.]
A large evergreen tree with a narrow cylindrical crown and very dark foliage; flowers monoecious.
2745 m. Vegetative. Common. *Sharma & Badola 922.*

Cedrus deodara (Roxb.) G. Don (*C. deodara* Loud.)
A large tree with greyish-brown bark and dark green, glaucous or silvery, sharply pointed leaves; cones barrel-shaped.
2590 m. Vegetative. Common. *Sharma & Badola 798.*

Picea smithiana (Wall.) Boiss.
A tall, evergreen tree of pendulous habit; flowers monoecious.
2590 m. *Sharma & Badola 799.*

Pinus wallichiana A. B. Jackson (*P. excelsa* Wall. ex Don)
A large tree.
2745 m. Vegetative. Common. *Sharma & Badola 921.*

PTERIDOPHYTES

Hymenophyllaceae

Mecodium polyanthos (Sw.) Copeland
2835 m. Vegetative. Leaves cream coloured. Occasional on tree trunks. *Sharma & Badola 882.*

Pteridaceae

Adiantum venustum D. Don
2895 m. Fertile. Common at places. *Shar-*

ma & Badola 878.

Coniogramme fraxinea (D. Don) Diels.
2290 m. Fertile. Occasional. *Sharma & Badola 1010.*

Onychium japonicum (Tnbg.) Kzl.
2745 m. Fertile. Common. *Sharma & Badola 850;* 2590 m. Fertile. Abundant at places. *Sharma & Badola 993.*

Pteridium aquilinum (L.) Kuhn.
2745 m. Vegetative. Frequent. *Sharma & Badola 919.*

ASPIDIACEAE

Dryopteris odentoloma (Moore) C. Chr.
2745 m. Vegetative. Frequent. *Sharma & Badola 923.*

Polystichum squarrosum (D. Don) Feé
2895 m. Fertile. Occasional. *Sharma & Badola 868.*

POLYPODIACEAE

Crypsinus malacodon (Hook.) Copeland
3050 m. Fertile. Common on moist rocks. *Sharma & Badola 931.*

Drynaris propinqua (Wall. ex Mett.) J. Sm.
2745 m. Fertile. Occasional on tree trunks. *Sharma & Badola 914.*

A Catalogue of the Birds in the Collection of the Bombay Natural History Society—19

Hirundinidae

HUMAYUN ABDULALI

[*Continued from Vol.* 72(2):505]

325 specimens of 27 species and subspecies up to No. 932 in INDIAN HANDBOOK and registered No. 24185 are covered by this part.

EL **Riparia riparia riparia** (Linnaeus) (Sweden) Collared Sand Martin

1 ♂ *Kurna, Mesopotamia.* Wing 101; bill 5·5; tail 47.

This was collected from migrating flocks on 4th July 1917 and is marked *riparia* by Ticehurst. Except for a shorter (and wider?) bill, I cannot distinguish it from *diluta* (910).

It may be mentioned that Ticehurst in 'The Birds of British Baluchistan' (*JBNHS 31*:869) identified two birds obtained by Meinertzhagen in North Baluchistan as of the nominate race.

910 **Riparia riparia diluta** (Sharpe & Wyatt) (Chimkent, north of Tashkent) Siberian Collared Sand Martin

8: 5♂♂ 1♀ 2?

1 *Kashgar, Chinese Turkestan;* 2 Chitral, N.W. F.P.; 1 Jagadhri, Ambala, 1 Tara Devi, 7000′, Patiala, Punjab; 1 Khahi, Pithoro, Sind; 2 Nandur-Madhmeshwar, Nasik, Maharashtra.

♀ 18061 Tara Devi, Patiala, with a 97 mm wing is left with *diluta* because of a 45 mm tail.

The specimens from Nandur-Madhmeshwar, Nasik, extend the recorded range of this subspecies (see *JBNHS 72*:853-854).

Measurements loc. cit.

910a **Riparia riparia indica** Ticehurst (Jhelum, Punjab) Indian Collared Sand Martin **3**:233

11: 6♂♂ 5♀♀

1 Attock, 3 Campbellpur, 2 Rawalpindi, 2 Madhopur, Gurdaspur, Punjab; 1 Okhla, Delhi; 2 Manjhaul, Monghyr District, Bihar.

See note on validity of this subspecies and measurements (loc. cit.).

911 **Riparia riparia ijimae** (Lönnberg) (Tretia Padi, Sakhalin) Eastern Collared Sand Martin **3**:234

9: 3♂♂ 2♀♀ 4o?

2 *Rham*, 14700′, *Tibet;* 1 Nal, Ahmedabad, Gujarat; 1 *c.* 15 m. off Bassein, 1 Mahim, Bombay; 1 Thana District, Maharashtra; 2 Manjhaul, Monghyr District, Bihar; 1 Kaziranga, Assam.

See note on extension of range of *ijimae* and measurements (loc. cit.).

912 **Riparia paludicola chinensis** (J.E. Gray) (China) Indian Greythroated Sand Martin **3**:235

24: 16♂♂ (1 juv.) 8♀♀

1 Lahore, 2 Bhajji State, 1 Labru near Ambala, 2* Jagadhri, 1 Chachran, 1 Ambala, 1 Chandigarh; 1 Faraknagar, 2 Delhi; 2 Jajjah Abbasian, Bahawalpur; 2 Vaghjipur, Mehsana, Gujarat; 1 Orissa; 2 Goalpara, 3 Dibrugarh, Assam, 1 *Dalu, Chindwin;* 1 *Myogwin, Henzada, Burma.*

One from Jagadhri, Ambala District, Punjab, and another from Faraknagar near Delhi, were listed under *R. riparia,* of which a specimen was taken on the same day. The former

is a juvenile with a white throat, pale rufous edges to the primary-coverts, and with a wash of the same colour on the back, affecting all the feathers on the rump and forming a distinct pale patch which must be very noticeable in the field.

Measurements on p. 355

IND. HANDBOOK (*5*:52) refers to its occurrence at Bombay, Nasik and Satara (*c.* 18°N) in Maharashtra. Barnes in 'Nesting in Western India' (*JBNHS 4*:3) writes "it is common in suitable places in most parts of western India but not from Ratnagiri. Permanent resident breeding, November to March or even later." Bombay then extended as far north as Sind, and I cannot trace any definite record south of Gujarat.

The two females from Dibrugarh, Assam (8092) and Myogwin, Henzada, Burma (8094) have white chins and almost no trace of grey on the breast. They differ from the juvenile in the absence of any rufous above, and can be separated from *R. riparia* by the lack of the tuft of feathers on the leg.

913 **Hirundo rupestris rupestris** Scopoli (Tyrol) Pale Crag Martin **3**:236

18: 11♂♂ 3♀♀ (1 juv.) 4 o?

1 Marmatai Range, Waziristan; 1 Kilia Drosh, 2 Drosh, 2 Chitral, 1 Kurbu 9000', 1 Khachar, Ladak; 1 Sanjauli, 5 Simla; 1 Patiala; 1 Pandwa, Surat Dangs; 1 Mandhikeri, M.P.; 1 Ambarnath, Thana, Bombay.

Measurements on p. 355

Birds collected earlier than around 1920 are faded and have much paler upperparts than others.

♀ No. 18074 collected at Simla on 31 October 1943 and marked juvenile has pale rufous fringes to the wing quills and the upper tail-coverts.

914 **Hirundo concolor concolor** Sykes (Dukhun) Dusky Crag Martin **3**:237

14: 8♂♂ (1 juv.) 3♀♀ 3 o?

1* Ambala, Punjab; 2 Bhujia Fort, Kutch; 1 Pandwa, Surat Dangs; 1 Kuno, Gwalior, 2 Chikalda, Berar; 1 Elephanta I., Bombay, 2 South Konkan; 1 Karwar, N. Kanara; 1 Wynaad; 1 Aramboli, S. Travancore; 1 Cumbum Valley, Kurnool District.

♂ No. 18079*, marked "juvenile by skull" is the northernmost available and has the darkest underparts.

Measurements on p. 355

915 **Hirundo obsoleta pallida** (Hume) (Sind) Pale Grey Martin **3**:238

4: 2♂♂ 2♀♀

1 *Putak,* 1 *Surbug, Qasrqand, Persian Baluchistan;* 1 Tankkaur, 1 Manguli, Jhalawan, Kalat, Baluchistan.

	Wing	Bill	Tail
♂♂	118,121	8·5,8·7	49,49
(IH	116-125	7-8	49-52)
♀♀	118,119	8·3 (2)	49,49
(IH	118-123	7-8	49-52)

916 **Hirundo rustica rustica** Linnaeus (Sweden) Western Swallow **3**:240

43: 24♂♂ 11♀♀ 8 o?

1 *Rossiten;* 1 *Borarka, Dist. Zempelberg, West Prussia (Poland)*; 3 *Kazimain, Baghdad,* 2 *Basra District,* 1 *Hawi Plain, Samarra, Mesopotamia;* 5 *Shiraz,* 1 *Gulahek, Teheran,* 1 *Hafr Al Atj,* 1 *Fao,* 7 *Charbar, Persian Gulf;* 1 *Kashgarh, Chinese Turkestan;* 1 300 *m. off Africa,* 18°25'N., 64°30'E.; 2 Mand, Baluchistan; 1 Chitral Drosh; 1 Srinagar, Kashmir; 3 Peshawar N.W.F.P.; 1 Jagadhri, Ambala, 1 Jajjah, Abbasain, Bahawalpur, Punjab; 1 Delhi; 1 Bhavnagar, Gujarat; 1 Nandur-Madhmeshwar, Nasik, 2 Wada, Thana, Maharashtra; 2 Jabbalpur, M.P.; 2 Kanpur, U.P.

While specimens of *H. r. tytleri* (No. 918) are very distinctive, nominate *rustica* and *gutturalis*, both accepted from Indian limits, are difficult to separate. The eastern bird *gutturalis* is said to differ from nominate *rustica* by:

(a) the pectoral band being broken by the rufous of the chin,
(b) the slightly smaller size, and
(c) the purer white underparts.

Ticehurst (*JBNHS 32*:349) dealing with

birds from northwestern India, has referred to the overlap of these characters and identified all of them as nominate *rustica* on the basis of a larger wing—west Europe ♂♂ 124·5-132 mm, ♀♀ 122-126 mm, *contra* NE. Asiatic *gutturalis* ♂♀ 109-120, mostly under 118 mm.

Separating those with wings over 115 as nominate *rustica* and the smaller ones as *gutturalis,* the latter agree more closely in the other characters and are all from the eastern and southern portions of the country. Two specimens of *gutturalis* from Batchian, Wallacea (collected by Wallace in 1859) borrowed from British Museum (Wing ♂ 118, ♀ 108) have the underparts purer white than any available in Bombay.

Of two males out of a flock near Wada, Thana, Bombay, obtained on 1 December 1973, one has a 118 mm wing and the other 113 mm. The latter lacks the rufous on the forehead and has a white chin *contra* rufous in the adult. Another "off Africa" with dusky upperparts and very little bluish sheen above (wing 116) has a broad dusky collar, enclosing a small white patch on the chin. The white throat appears in juvenile (?) specimens under *gutturalis* also.

Vaurie (1951) has also dealt with the difficulty of telling these two races apart.

♂♂	Wing
rustica (20)	117-130 av. 123 (IH 120-129)
gutturalis (22)	110-116 av. 112 (IH 110-123)
tytleri	115-119 av. 117 (IH ♂♀ 115-124)
♀♀	
rustica (11)	118-126 av. 122·5 (IH 116-128)
gutturalis (7)	98-116 av. 109·5 (IH 108-113)
tytleri	114,115,120

917 **Hirundo rustica gutturalis** Scopoli (Philippines) Eastern Swallow **3 : 241**

38: 22 ♂♂ 10♀♀ 6 o?

2 Bhimasar, Anjar, Kutch, 1 Kharaghoda, 1 Dabka, Baroda, 1 Nandur-Madhmeshwar, Nasik; 1 Delhi; 1 Tulsi, 1 Wada, 1 Ambernath, 1 Thana, 1 Powai, 1 Juhu, 5 Bandra, Bombay; 1 Kottayam, Vembanad Lake, Backwaters, 1 Cape Comorin, Kerala; 2 Cumbum Valley, 1 Dodipatti, Madhubani, Tirhut, Bihar; 1 Dibrugarh, Assam; 1 Port Blair, 2 Narcondam I., Andamans; 1 *Shurdaung,* 1 *Prome,* 1 *Maymyo,* 1 *Tenasserim, Burma;* 6 *Peking,* 1 *Tienstin, China;* 1 no data.

Juveniles have dull coloured heads, the chins white mixed with rufous, and the breast bands sooty, rather than black or chestnut as in the adults.

One specimen No. 8159 marked '? juvenile' collected by J. P. Cook at Maymyo, Burma, on 23 May 1913 has the white of the chin connected with that of the underparts—the dark pectoral band showing only at the sides of the breast and connected by a faint tinge.

Measurements and remarks under 916.

In December 1962, a number of swallows were netted and ringed at a roost in mangrove at Mahim, Bombay. Of 974 birds measured, 788 (81%) had their wings 105-115 mm (av. 111·3) and the remainder (186 birds = 19%) measured up to 127 mm (av. 119·1). The average weight of the smaller birds was 14·44 gm *contra* 15·2 gm in the larger.

918 **Hirundo rustica tytleri** Jerdon (Dacca) Tytler's or Chestnut-bellied Swallow **3 : 242**

9: 6♂♂ 3♀♀

1 Bhutan Duars, 8 Goalpara, Assam.

Measurements under 916.

919 **Hirundo tahitica domicola** Jerdon (Nilgiri Hills) Nilgiri House Swallow **3 : 244**

3: 2♂♂ 1♀

1 Runnymede, 4600′, Nilgiris; 1 Mutherkutty, 1 Travancore.

Wing 103,103,105 (IH 99-105); bill 7·8,8,8·3; tail 43,44,46 (IH 44-47).

920 **Hirundo tahitica javanica** Sparrman (Java) Javan House Swallow **3 : 243**

1♀ South Andamans

Wing 109 (97-107); tail 47.

The bill is broken but does appear wider than in *domicola*.

921 **Hirundo smithii filifera** Stephens (India) Indian Wiretailed Swallow **3**: 245

14: 7♂♂ 7♀♀

1 Bhagat State, 1 Solon 5000′, 1 Kandaghat, Patiala, 1 Lahore, Punjab; 1 Dodi, Malwa Plateau, C.I.; 1 Ajwa, Baroda, 1 Walwan, Lonavla, Poona; 1 S. Konkan; 1 Karwar, Kanara; 1 Meerut, 1 Almora, 2 Darwar, Ranikhet, U.P.; 1* *Thayetmyo District, Burma.*

Measurements on p. 355

There is considerable variation in the intensity of chestnut on the head which is palest in No. 18092, a ♂ with enlarged testes obtained at Bhagat State 3500′, Simla Hills on 26th June 1922, no doubt breeding. Could this be *H. s. borbinskoii* Stakhanow from Chekov, separated for its paler head?

♀ No. 8197 from South Konkan with a 132 mm wire in tail is probably wrongly sexed.

922 **Hirundo fluvicola** Blyth (Bundelkund) Indian Cliff Swallow **3**: 246

10: 4♂♂ (2 juv.) 3♀♀ 3 o?

1 Doraha, Punjab; 2 Keoladeo, Bharatpur, Rajputana; 2 Ajwa, Baroda, 1 Dohad, Gujarat; 1 Madhmeshwar, Nasik, 1 Ambernath, Kalyan, 1 Shil, 1 Sanpada, Badlapur, Thana, Bombay.

	Wing	Bill	Tail
♂♀	89-94	6·2-6·7	37-43
	(89-94	*c.* 6	40-44)

o? 8203 Shil, Thana, near Bombay (10 Dec.) has a paler head on which the central streaks are more visible.

The two from Bharatpur, a ♂ and a ♀ (11 May) appear juveniles. The spotting on the breast is not as distinct as in the adults and the heads, though darker than in 8203, lack the rufous tinge and are more heavily streaked.

923 **Hirundo daurica daurica** Linnaeus (Siberia) Daurian Striated Redrumped Swallow **3**: 248

nil.

The size of the wing (125-133) and the buffiness of the underparts of four topotypical specimens borrowed from the British Museum (N.H.) leave no doubt that none of the specimens now in our collection is of this race. Stuart Baker's records of its breeding at Shillong, Assam, probably refer to *H. striolata mayri*, No. 929, q.v.

924 **Hirundo daurica rufula** Temminck (Egypt) European Redrumped Swallow **3**: 252

4: 2♂♂ 2♀♀

3 Chitral, N.W.F.P.; 1 Hannah (Baluchistan?)

The last was collected by J. W. N. Cumming on 1st May 1909 at Hannah, which place cannot now be traced but is probably in the northwest.

All were obtained in April-May and can be distinguished from birds from further east (Simla, Garhwal, Nepal) by the white edges to the pale chestnut of the rump, the almost complete absence of streaks on the breast and the broad rufous collar round the neck. The last character is to some extent dependent on the method of preparation of the skin, but none of the others have it so distinct.

The adults are very similar to the young of *nipalensis* (q.v.) from their breeding grounds at Simla.

Ticehurst (1933, *Ibis*: 547) held that Seebohm's *scullii* was smaller (wing 111-121) than *rufula* (120-127). Earlier (1922, *Ibis*: 662) he had recorded two young near Karachi on 18 November 1919. In 'The Birds of Central India' (1939, *JBNHS 41*:103), Whistler identified a pale-rumped, finely-streaked and long-tailed specimen from Santanwara, Gwalior, as of this race but this record is omitted in subsequent literature. Vaurie (1951, *Amer. Mus. Novit.*, No. 1529:34) measured 23 ♂♂ as 117-128 (av. 121-HA) and 13 ♀♀ 116-127 (av. 119) and decided that *scullii* was synonymous with *rufula.* Though his speci-

mens ranged from Morocco to Eastern Afghanistan, he had none from Indian limits. The specimens now available measure ♂ wing 117, tail 92 (one damaged) and ♀♀ wing 112, 115, tail 87, 98, which certainly support Ticehurst's conclusions, and the matter requires re-examination. The Hannah bird is marked as smaller than *rufula* by the collector.

925 **Hirundo daurica nipalensis** Hodgson (Central Nepal) Himalayan Striated Red-rumped Swallow **3**: 250

53: See details below.

These birds fall into three groups:-

(a) 20: 11♂♂ (4 juv. 1 fldg.) 6♀♀ (2 juv.) 3 o? (1 fldg.)

15 Simla, 6500′-7000′; 1 Koti State, 1 Fagoo, 8000′, Keonthal; 1 Lohba, 1 Karnuprayag, Garhwal, U.P.; 1 Bijaypur, Nepal.

All these taken between 30th April and 7th September have their underparts finely streaked as in *erythropygia* and rumps paler than in (b). The juveniles differ from the adults in having the rump more fringed with white and the breast more sparsely streaked. In fact they are very similar to adult *rufula/scullii* and would have been so listed had not adults been obtained at the same time. This form may be only an altitudinal migrant which does not leave the Himalayan foothills. Hodgson when describing this said it was the common swallow of the central region of Nepal, and in view of the possibility of more than one form occurring in Nepal, I am restricting the type locality to Central Nepal.

Of two specimens from Nepal borrowed from U.S. National Museum, No. 391014 (4 April 1947) from Gokarna, Central Nepal, could be included in (a) while 391023 (4 Oct. 1947) from Thankot (27° 41′N., 85° 11′E.) agrees with those in (b).

(b) 29: 15♂♂ 8♀♀ 6 o?

3 Jagadhri, Ambala, Punjab; 2 Radhanpur, 1 Dhari, Amreli, 1 Cambay, 1 Dabka, Baroda, 1 Dohad, Gujarat; 3 Ghoti, Nasik, 4 Wada, 1 Bhiwandi, Thana, 1 Sion, Bombay, 2 Khopoli, Kolaba, 1 Mehda, Satara, 1 Sholapur Road; 1 N. Kanara; 2 Orcha, Bastar, M.P.; 1 Orissa; 3 Meerut, U.P.

It has been customary, at least in Indian literature, to accept the form(s) visiting India in large flocks during the cold weather, as *nipalensis*, but these specimens (several of which have been recorded as *nipalensis*) appear to be different from the population resident in the Himalayas listed under (a). Though there are differences in individuals from the same flock, in series, the streaks are broader and more numerous, and the chestnut of the rump is darker and more consistently streaked. A large proportion are birds of the year, without glossy upperparts, but these again cannot be matched with the juveniles from Simla, and the statement in IND. HANDBOOK (5:69) that "the streaks are coarser in winter" does not appear to be the correct explanation. The rufous (buffy) wash on the underparts varies and cannot be linked with sex or season. In some, the chestnut on the rump is almost as dark as in *erythropygia*, but always streaked *contra* unstreaked in adult *erythropygia*. It is noteworthy that Vaurie (loc. cit. p. 40) identifies *nipalensis* only from Nepal and northern Punjab and lists all the birds from continental India as *japonica* q.v.

(c) 4: 2♂♂ 2♀♀ 3300′ *North Shan States, Burma.*

All were obtained by J. P. Cook on 27th September 1913 and are marked *nipalensis*. In series they all show the rufous (buffy) wash on the underparts which are darker, and are more prominently streaked in the males. The females have the rumps distinctly paler, and they may both be birds of the year.

		Wing	Tail
(a)	♂♂	112-117 av. 114·3	91-102 av. 96
(b)	♂♂	113-120 av. 116·2	63-98 av. 81·6
(c)	♂♂	110,116	87,89
(a)	♀♀	111,114 (2), 115	83,88,90,91
(b)	♀♀	111-119 av. 115·4	73-95 av. 81·3
(c)	♀♀	112,115	70,77
(IH	♂♀	111-123	81-102, once 107)

926 **Hirundo daurica japonica** Temminck & Schlegel (Japan). Japanese Striated or Red-rumped Swallow.

7: 4♂♂ 2♀♀ 1 o?

1* Delhi; 2 Goalpara, Assam; 2 *Hlwa Chang, Thayetmyo,* 1 *Prome,* 1 2500′ *Nabudaung, Sandoway District, Burma.*

♂ Specimen No. 18102* obtained by Basil-Edwardes at Delhi on 16 November 1924 out of "numbers perched on telegraph wires" was first listed (*JBNHS 31*:271) as *H. d. striolata* when it was mentioned that it had been sent to Dr. Ticehurst for identification. The measurements were noted: Wing 122 mm, tail 120 mm, depth of fork 68 mm. Later on page 578 (loc. cit.), Ticehurst was quoted "This is a very coarsely marked swallow on the underparts, but there are others equally coarsely marked in the British Museum from the Himayalas. It is much too small however for *striolata* and I consider it to be *H. d. nipalensis* which varies much in striation." A re-examination reveals that the label is marked "*japonica*" and initialled "CBT", an identification which appears to be correct.

The two males from Goalpara, Assam, are slightly larger (wing 120, 122) than the others under *nipalensis* (b), while the others from Burma are smaller but have been named *japonica* by some earlier worker and are left unchanged. As indicated earlier, several yet listed under *nipalensis* may have to be re-classified.

	Wing	Tail
♂♂	117,120,122,126*	81,89,96,108*
	(Vaurie,1951:114-125 av. 120	89-106 av. 97)
♀♀	115,119	90,95
	(Vaurie,1951:117,119,122	85,95,100)

In IND. HANDBOOK (*5*:66) the key to subspecies requires a wing "mostly over 120" but the measurements on page 70 are "♂♀ 114-126" which incidentally, are from Vaurie 1951, and not 1959.

927 **Hirundo daurica erythropygia** Sykes (Dukhun, Poona) Indian Striated or Red-rumped Swallow **3**:251

28: 16♂♂ 8♀♀ 4 o?

1 Nawashar, Jullundur, 1 3000′, 1 3500′, 1 Salogra 5000′, Baghat State; 1 Keonthal State 7000′, 1 Patiala; 1 Mubarikpur, 2 Ambala, 1 Karnal, Punjab; 1 Delhi; 1 Chanderi, 1 Kuno, Gwalior; 1 Jalor, 1 Hamavas, Pali, Jodhpur; 1 Rudramath, 1 Bhujia Fort, Kutch; 1 Ghatwad, South Kathiawar; 1 Chikalda, Berar; 1 Pandwa, Surat Dangs; 1 Jubbalpore; 1 Goregaon, Bombay; 1 Thattekad, Travancore; 1 Kodaikanal, 1 Tope, Palnis; 2 Kodura, South Cudappah; 1 Janai, Almora.

Sykes when naming *erythropygia* in 1832 said he had obtained it out of a large flock and this immediately indicates the migrant form known as *nipalensis* (or *japonica*?) and to which this name would apply! I am however continuing to use *erythropygia* for the race resident in India, leaving it for somebody else to examine this aspect further.

The underparts are very finely streaked and very similar to *rufula*/*scullii* in this respect. The rump is however much darker and without any streaks, a character by which it can be separated from *nipalensis.*

Sp. 8243 a ♀ obtained in Jodhpur on 19th October 1933 and marked *nipalensis*? by Whistler, has a pale, almost cream-coloured heavily-streaked rump. The underparts are more coarsely streaked than in adult *erythro-*

pygia, but the 106 mm wing and 72 mm tail suggest a juvenile of this subspecies. A similar bird from Belgaum, Karnataka (21st Oct.) in St. Xavier High School collection (wing 110, tail 68) and two fledglings handled in a nest under a bridge near Karnala Bird Sanctuary, Pen, Kolaba, Maharashtra on 14th June 1975 support this identification. Sp. No. 20437 from Goregaon near Bombay is a very poor specimen, but the pale rump and the date (21st Aug.) suggest a juvenile of this race.

	Wing	Tail
♂♂	109-117 av. 112·5	67-83 av. 75
♀♀	103-113 av. 107	70-78 av. 74
(IH ♂♀	104-116	70-82)

Ticehurst (*JBNHS 32*:350) said that this form ascended to over 4000′ and bred in the same area as *nipalensis*. This was repeated by Jones in 'Birds of the Simla and adjacent Hills' (*JBNHS 47*:431-432) but queried by the editors. This aspect certainly requires a careful re-examination in the field.

928 **Hirundo daurica hyperythra** Blyth (Ceylon) Ceylon Striated or Redrumped Swallow **3**:253

nil.

929 **Hirundo striolata mayri** Hall (Singhaling, Hkamti, Upper Chindwin, Burma) Chinese Striated or Redrumped Swallow **3**:249

4 o? nestlings. Shillong, Assam.

The young taken by Stuart Baker on 28th May 1908 have broad streaks on the underparts, those on the breast forming a patch. Traces of the black thigh patches are present and the rump is pale and streaked.

Vaurie (1951, *Amer. Mus. Novit.*, 1529:31) refers to an adult *substriolata* (= *mayri*) caught on the nest at Shillong on 15th May and a juvenile, barely out of the nest on 22nd June.

EL **Hirundo striolata stanfordi** (Mayr) (Tama, 1000 ft, Myitkyina District, Upper Burma) Burmese Striated or Redrumped Swallow

1 ♂ *Galsunk* (?), 2000′, *South Shan States, Burma.*

Wing 133; central tail 49, outermost 100, fork 51.

The bird collected on 10 August 1913 is marked as breeding. No adults of *H. striolata mayri* are available but the underparts are more heavily streaked than in *H. d. japonica* (926) and the rump is also darker and more distinctly streaked.

930 **Delichon urbica urbica** (Linnaeus) (Sweden) European House Martin **3**:226

9:3♂♂ 5♀♀ 1 o?

1 *Haftquil, Persian Gulf;* 3 Koti State, 1 Tara Devi 7000′, Patiala, NW. Himalayas; 1 Khorchar, 11000′, Ladak; 3 Songadh Fort, Navsari, Gujarat.

Measurements on p. 355

931 **Delichon urbica cashmeriensis** (Gould) (Kashmir) Kashmir House Martin **3**:228

5: 1♂ 4♀♀

2 Chitral Drosh, 15000′, 1 Chitral, N.W.F.P.; 1 Dachigam, 1 Kashmir.

These cannot be separated from nominate *urbica* by the smoky grey or greyish white of the lower plumage (IND. HAND. 5:73) but the measurements (under 930, p. 355) of the wing, tail and fork in tail are almost exclusive. Though not apparent from the measurements, the bills are also smaller than in *urbica* (excluding one specimen from Haftquil) and *lagopoda*.

EL **Delichon urbica lagopoda** (Pallas) (Dauria)

1 ♀ *Taunggyi, S. Shan States, Burma.*

Wing 111; bill 7·3; tail 49, fork 6.

The specimen is marked *whiteleyi* which is now synonymised with *lagopoda*. The area of white on the rump appears larger than in the others.

932 **Delichon nipalensis nipalensis** Moore (Nepal) Nepal House Martin **2 :** 230

6: 3♂♂ 2♀♀ 1 o?

2 Ranibagh, Kumaon, U.P.; 1 Kewzing, W. Sikkim, 2 Sikkim; 1 Dening, Lohit Valley, NE. Assam.

	Wing	Bill	Tail
♂♀	91-100 av. 96	5·5-6·6 (6·1)	35-40 (38·5)
(IH	90-98	from skull 7-9	37-41)

Three unregistered birds from Central and Western Bhutan with wings 97, 98, 98 are included in the measurements and the largest (100) is from NE. Assam, showing an increase in size eastwards towards *cuttingi* (type Gangfang, 5500′, near Burma-Yunnan Border). The black is restricted to the chin and can hardly be said to occur on the throat except for a large greyish brown patch in the easternmost specimen. All have black patches on the sides of the breast which do not meet across the breast to form a band.

Measurements

912 **Riparia paludicola chinensis** (J. E. Gray)

	Wing	Bill	Tarsus	Tail
♂♂	85-96 av. 91·6	5·4-6·8 av. 6·1	*c.*10-11	36-42 av. 39·7
♀♀	85-95 av. 91	5·5-6·6 av. 6·1	*c.* 11	36-42 av. 38·8
(IH ♂♀	90-96	from skull *c.*8	10-11	37-45)

913 **Hirundo rupestris rupestris** Scopoli

	Wing	Bill	Tarsus	Tail
♂♂	127-133 av. 129·8	8-9 av. 8·7	11-12	30-55 av. 52·8
♀♀	130,130,133	7.9,8,8·9	11-12	53,54,55
(IH ♂♀	127-134	from skull 11-12	11-12	53-57)

914 **Hirundo concolor concolor** Sykes

	Wing	Bill	Tarsus	Tail
♂♂	105-112 av. 109·4	7-8·3 av. 7·4	10-11	42-45 av. 43·5
♀♀	107,108,112	7·6,8,8	10	43,44,45
(IH ♂♀	105-113	from skull 9-11	9-10	42-46)

921 **Hirundo smithii filifera** Stephens

	Wing	Bill	Tail Central	Tail Outer
♂♂	108*,115-126 av. 120·7	6·5-8·5	35-39	86-178
	(IH 113-122	from skull 11-12		109-173)
♀♀	114-117 av. 116	7·5-8·7	35-38	49-72 one 132
	(IH 108-116	from skull 11-12		51-71)

930 **Delichon urbica urbica** (Linnaeus)

		Wing	Bill	Tail	Fork
Nominate *urbica*	♂♀	107-115 av. 111·2	6·5-7·6	54-59 (56·8)	13-18 (16)
cashmiriensis	♂♀	97-108 av. 101·8	6·2-7	47-48 (47·8)	7-11 (8·4)

(*to be continued*)

Key to Indian spiders[1]

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(*With eighty text-figures*)

Introduction

This paper on Indian spiders is intended as a popular guide for the identification of spiders at least upto the family and generic levels with notes on their habitats, behaviour and how to collect them and preserve them for scientific study or museum display. Spiders are geologically very old and although spiders are extremely abundant throughout the country from sea shore to the high Himalayan mountains, our knowledge of Indian spiders is extremely fragmentary. One of the earliest contributions on Indian spiders was by Stoliczka (1889), while Karsch (1873), Thorell (1895), Pocock (1900) and Gravely (1924) added considerably to our knowledge of Indian spiders.

During my study of spiders, over the last two decades, I felt the necessity for a handbook on spiders of India for the benefit of laymen as well as for the student for easy identification of Indian spiders as well as to create interest of Arachnology in them.

It would gratify me if this paper would serve in some measure to create some interest in the readers on spiders as a stepping stone for the future advancement of arachnology in India.

I am indebted to the following for help, encouragement and useful information of various kind: Dr. M. S. Mani, Emeritus' Professor of Entomology, St. John's College, Agra, Mr. J. C. Daniel, Curator, Bombay Natural History Society and Dr. M. Babu Rao, Zoological Survey of India, Western Regional Station, Poona.

What are spiders?

Generally Spiders are confused with Insects, however, spiders can be easily separated from insects by the following characters:

Spiders

1. Body divided into two unsegmented parts; cephalothorax (or head) and abdomen.
2. Cephalothorax has four pairs of legs and a pair of six segmented pedipalps modified in the male sperm for transport.
3. Wings absent; eyes simple, two to eight in number.
4. Respiration by book lungs and genital pore on the ventral side near anterior end of abdomen.
5. Silk apparatus always present, opening at hind end of abdomen below anus.
6. Poison apparatus opening on fangs of chelicerae.
7. Development direct, no larval stages, spiderlings resemble their parents.

Insects

1. Body divided into three parts; head, thorax and abdomen.
2. Head has a pair of antennae and the thorax three pairs of legs.

[1] Accepted February 1975.

3. Generally paired wings present in adult and eyes commonly compound ocelli.
4. Respiration by ostia and genital pore just below anus at posterior end of abdomen.
5. Silk apparatus absent in adults, present only in some larvae which open on the lower lip.
6. Poison apparatus, if present usually opening at posterior end of abdomen.
7. Development may have a metamorphosis with larval and pupal stages or with nymphs.

The class Arachnida includes many other animals like scorpions, whip-scorpions, pseudoscorpions, king-crab, solifugids, daddy-long-legs, ticks and mites. The daddy-long-legs (harvestmen) are often confused with spiders mainly with the Pholcidae spiders. But the former may be readily separated from spiders by the fact that they have the abdomen noticeably segmented and broadly joined to the cephalothorax and also lack the spinnerets at the posterior end of the abdomen.

Habitat of spiders

Spiders make up a considerable portion of the animal life of this vast and diversified land. They are widespread and are found in all types of habitats and occupy all but a few niches.

Spiders may be found near water's edge, on the ground, in underground caves and the top of mountains. In fact jumping spiders have been collected from Mt. Everest (22,000 feet), the highest elevation at which any animal has ever been found. It is recorded that ballooning spiderlings have been collected from airplanes at an elevation of 5000 feet. Some spiders like Pholcidae, Oecobidae, Heteropodidae and Filistatidae live inside human habitations, and others frequent the walls outside. Almost every plant has its spider fauna, as do the dead leaves on the forest floors, and on trees in winter. They may be found under bark, under stones, under fallen logs, these are only a few examples of their various habitats. There may be different varieties of spiders even in a small area as for example almost 600 species of spiders are known from Connecticut, a very small state of America. The number of individuals is also very high in a given area. One worker in America found a population of 407,000 per acre of clay meadow, and another over 2,200,000 per acre of grassy field.

Some ground spiders like *Geolycosa* and trap-door spiders of Western Ghats dig holes in the ground and remain there during their whole life, except for the short period when the male ventures out to seek a mate. The silklined tunnel of *Atypus* extends partly into the ground, and partly along the surface of a tree. The wolf spiders, mainly *Lycosa* and *Hippasa* may make use of shallow holes in which they hide. Many gnaphosids and some clubionids run over the ground and have been found under stones in the foothills and in the forests.

Many spiders like Uloboridae, Pholcidae prefer dark and shaded places, where the humidity is high. Some *Pardosa* and *Lycosa* species are found along the edges of streams and ponds, running over the water surface quickly and in an emergency they can dive under water. *Araneus* and *Tetragnatha* species also prefer water sources but are usually found on the shrubs, which overhang the ponds or streams.

Many crab-spiders like *Thomisus* and *Misumena* live among flowers, waiting in ambush for insect visitors who come for nectar on the flowers. It was observed that crab spiders change their colour according to the colour of the petals of the flowers. *Tibellus, Thanatus* and *Oxyopes* run along green grass leaves or stems, clubionids and salticids hunt from leaf to leaf. Hersilid spiders live on the wall of houses and tree trunks; they are usually dark in colour like the bark of a particular tree or

wall, on which they occur.

The only social spider *Stegodyphus sarasinorum* Karsch, has attracted the attention of many naturalists in India. They build their nests in the foliage of *Acacia arabica* or *Zizyphus* sp.

Many species are found in tall grass, on bushes and trees. Some run over the branches and trunk and hide under loose bark and in crevices. Snares may be built among twigs and many linyphiids, theridiids and argiopids construct their webs in tall grass, bushes and tree foliage.

Some spiders mimic other animals and among these the ant-like species are most common. Many examples are known in several families and often the mimicry extends not only to the shape of the body but sometimes to the behaviour too.

Collection and preservation of spiders

The collection of spiders is very easy as they are available in a variety of habitats.

One of the oldest collection methods for getting spiders in large numbers is by using a sweep net, through tall grass and weeds and picking out the spiders from among the insects, leaves and debris that will be gathered with them. It is more effective if an umbrella is inverted underneath flowering shoots or bushes and to thoroughly shake the shoots or bushes, when spiders along with a variety of insects, mites etc. will be collected in the umbrella. After removing the leaves etc. from the umbrella the spiders can be transferred into collecting tubes containing 75 per cent alcohol with the help of a fine brush. It is very essential to see that only a small number of specimens of spiders are kept in a single tube, otherwise spider specimens will be preserved in bad shape due to the pressure of the upper layers and this type of preserved specimen is not useful for scientific study.

For purposes of scientific study, when the specimens preserved in alcohol are brought to camp or laboratory, from the field, the collection should be transferred into a petri dish after two or three hours and the spiders separated and preserved in the following manner:

The ideal way of preservation is to keep the specimens in a petri dish containing 75 per cent alcohol and adjust the body parts (legs etc.) as it is in live condition with the help of brush, forceps and needle. The specimens should be kept in this condition in the petri dish overnight before transferring them into tubes for permanent preservation.

The Mygalomorph spiders which live in burrows and which are big in size are best collected by keeping an empty tube against the burrow and allowing the spider to crawl into the tube. The spider is then put in a *Cyanide bottle* for killing. Later it is transferred into a tube containing 75 per cent alcohol.

The smaller spiders, especially those belonging to the families Oonopidae, Caponiidae, which live under the barks of big trees need careful search to locate them. A brush dipped in alcohol should be used to transfer the small spiders from under the barks into the tubes containing alcohol. In all cases too many specimens should not be put in one specimen tube and as far as possible the specimens should be arranged in their natural posture before preservation. Whenever there are more than one specimen in a tube, the tube containing the specimens should be filled with alcohol upto $\frac{3}{4}$th height and the tube should be very lightly shaken horizontally to allow the specimens to spread out. Then the tube should be kept in horizontal position overnight so as to allow the specimens to spread out and get fixed in that position. Later

on the tube can be kept in normal position for permanent preservation.

Spiders can be arranged in a petri dish or cavity block in alcohol medium and studied under binocular microscope.

Name of body parts of spider

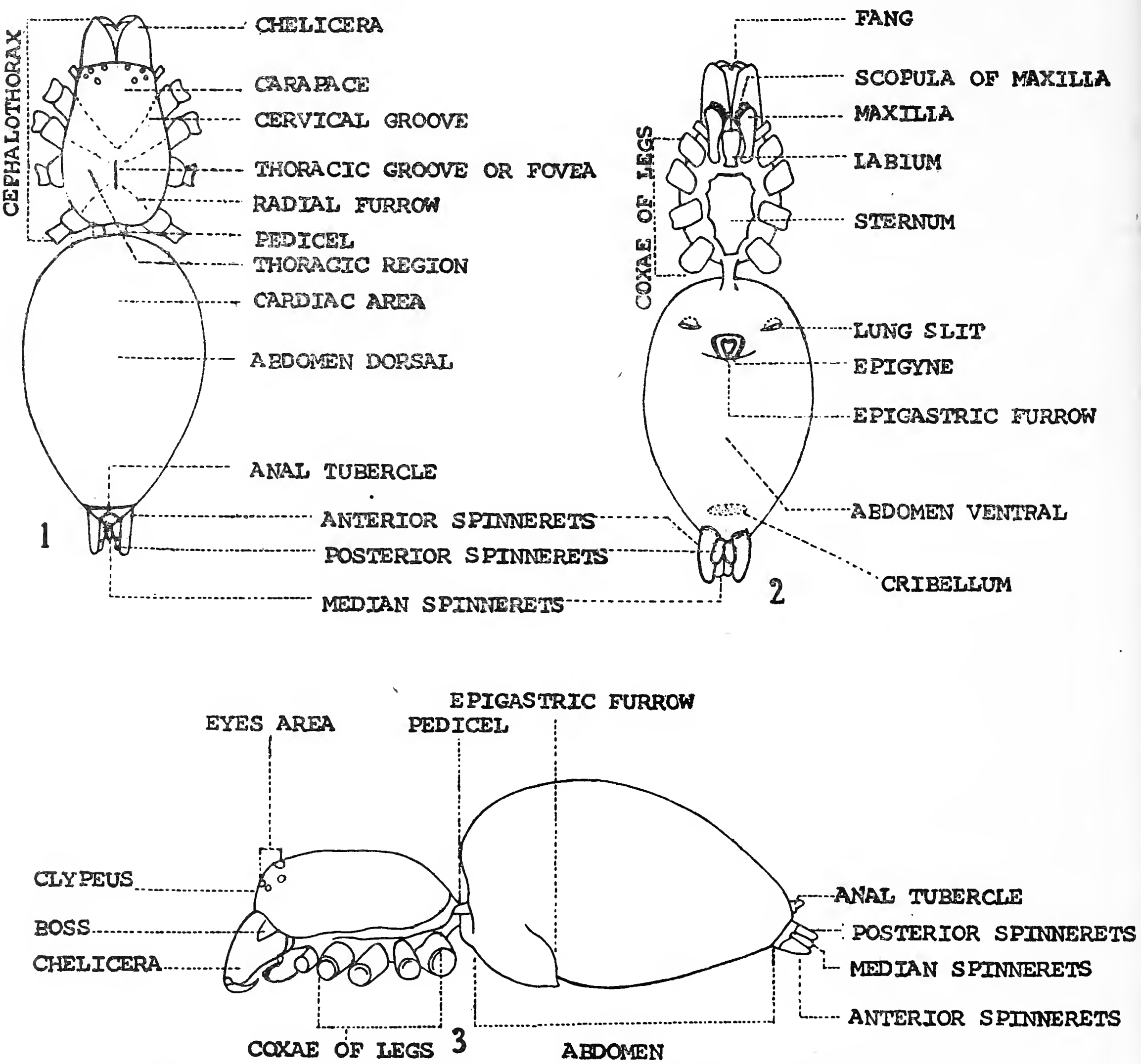
The body of the spider is divisible into a distinctive *cephalothorax* and *abdomen*, jointed together by a narrow *pedicel*. The *cephalothorax* is covered dorsally by a hard sclerotic shield, the *carapace*, and ventrally by the *sternum*. The anterior margin of sternum articulates movably with the *labium*. With few exceptions there is a deep transverse groove, forming a kind of hinge, between the sternum and the labium. The legs are articulated in the pleural membrane between the lateral edges of the *carapace* and *sternum*. On the cephalic region are present two to eight simple eyes. The eyes are generally of two kinds, namely, black or *diurnal* and white or *nocturnal* eyes. When only one type is present, the condition is described as *homogeneous* in contrast to the *heterogeneous*, when both the types are present. The eyes are usually arranged in a double row, an *anterior row* and a *posterior row*. Each row usually contains four eyes. The eye row is described as *recurved*, when the concavity of the curve is directed backward, and as *procurved* when the concavity is turned forwards. According to their position, the eyes are described as the *anterior medians*, the *posterior medians*, the *anterior laterals* and the *posterior laterals*. The cephalic area, occupied by the eyes, is known as *ocular area*. The area margined by the four median eyes is termed *ocular quad*. The area between the anterior row of eyes and the base of chelicerae is the *clypeus*. The space between the anterior median eyes and the margin of clypeus represents the *width of clypeus*. There is often a depression in the middle of the thorax, called *thoracic groove*. A convex, lens-like, black or deep brown mark called fovea replaces the thoracic groove in the families Gnaphosidae and Drassodeae.

The *chelicerae* are the first pair of appendages of the cephalothorax. Each chelicera bears a curved *fang* at its apex. The inner surface of chelicera may be finely denticulate and may also have a groove, into which the fang can be closed when not in use. This groove may also be armed with teeth on each side; the outer row of these teeth is described as *promargin* and the inner row as *retromargin*. There are sometimes long stout hairs on the promargin to constitute the so-called *fang scopulae*.

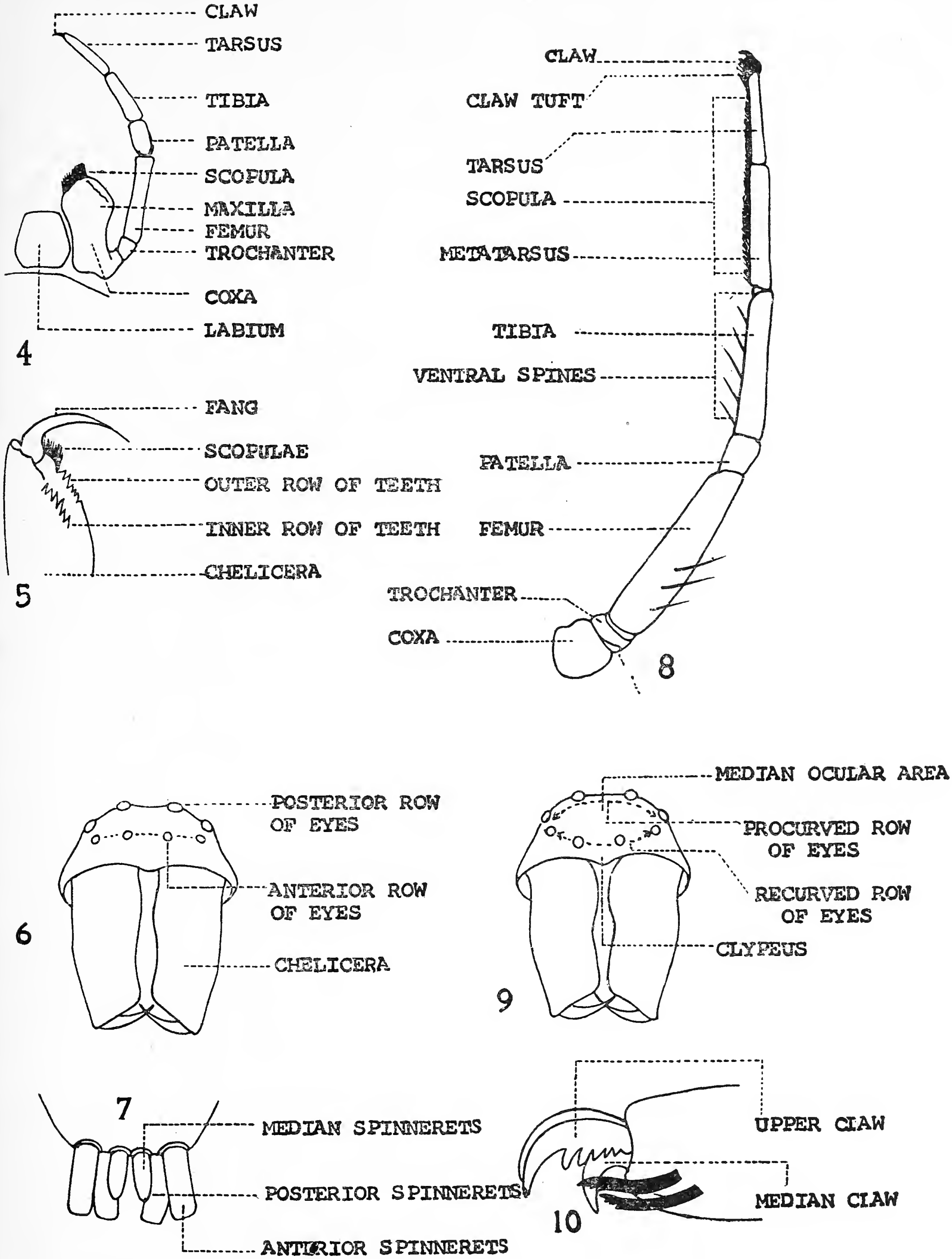
The pedipalps are the second pair of appendages. The *palp* proper is composed of six segments, *coxa, trochanter, femur, patella, tibia* and *tarsus*. In females the tarsus is simple and may or may not be with a single claw. In mature males the tarsus of palp is modified to carry a more or less complicated *copulatory organ*. Generally the tibia, sometimes also the patella constitute *apophyses* (which may be of different variety of shapes in different species) and which is of important taxonomic value. In many spiders the tarsus has a bowl-shaped cavity on its ventral surface called *cymbium*. In many groups mature males are provided with an appendage, the *paracymbium*. The structure of mature male palp is very important for generic or specific identification of spiders. The complicated palpal organ has many parts, but that is a matter beyond the scope of this paper. There are four pairs of legs designated I, II, III and IV respectively. Each leg is composed of seven segments, *coxa, trochanter, femur, patella, tibia, metatarsus* and *tarsus*. The legs are variously

clothed with spines, spinules, bristles and hairs of various types. The tarsus ends are provided with two or three claws. A characteristic tuft of hairs called *claw-tuft* is sometimes found just above the claw. In the Gnaphosidae there are dense rows of hairs called *leg-scopulae* below the metatarsi and tarsi. Spines on the dorsal sides of legs are distinguished as *dorsal spines* and those on the ventral side as *ventral spines*.

The abdomen is produced posteriorly into a conical *anal tubercle* and bears three pairs of spinnerets ventrally, *viz.*, the first or the *anterior pair*, the second or the *median* and



Figs. 1-3. Three views of spider, without legs, showing parts labeled. (1) Dorsal. (2) Ventral. (3) Lateral.



Figs. 4-10. (4) Pedipalp of female. (5) Fang. (6 & 9) Face and chelicerae from the front. (7) Spinnerets. (8) Leg. (10) Claw.

the third or the *posterior pair* of spinnerets. In a number of families there is present in front of the anterior (ventral) spinnerets a seive-like plate, called the *cribellum*. The special type of silk emitted from this organ is combed by the calamistrum borne on metatarsus IV. In many families of spiders which do not possess the cribellum a conical appendage called the *colulus*, lies between the bases of the anterior spinnerets.

The ventral surface of abdomen is provided with one or two pairs of lung-books, followed by one or two paired spiracles. The female genital opening is the *vulva* or *epigyne*, with a transverse fold, known as *epigastric furrow*.

The tarsi of spiders are often armed with hairs of the type known as *tenent hairs*, i.e., hairs dilated at their tips, and as in insects, secrete an adhesive fluid. Setae which are stout apically and clubshaped, as in *Oxyptila*, are called *clavate hairs*, Argiopidae have very fine hairs known as *pubescence*. Sometimes the hairs are modified as *spiny-hairs*.

Key for the identification of spiders

The key is based on characters that can be readily distinguished such as the number of tarsal claws, the arrangement of the eyes and manner in which the legs are turned. In the key, characters such as these are arranged, in couplets, each half of the couplet bearing the same number but different letters, as 1a, 1b, 2a, 2b, and so on. The characters given are contrasting, and the student, while examining the specimen, must decide which alternative fits. At the end of each statement of characters is a number indicating which couplet is to be tried next, until eventually a couplet line ends in a name, which should be that of the specimen in hand.

To assist the student in visualizing the position of any spider in the system a list is appended giving the placement of spider families in accordance with the view of the author. Those families whose names are preceded by a single asterisk have representatives in the Indian sub-continent.

List of families and higher categories of spiders

Order ARANEAE

Suborder—Orthognatha

Mesothelae (atypical tarantulas)

Family

*1. LIPHISTIIDAE Thorell 1869.
2. ANTRODIAETIDAE Gertsch 1940.
3. MECICOBOTHRIIDAE Holmberg 1882.
*4. ATYPIDAE Bertkau 1878.

Opisthothelae (typical tarantulas)

Family

*5. THERAPHOSIDAE Thorell 1869.
6. PARATROPIDIDAE Pocock 1903.
7. PYCNOTHELIDAE Petrunkevitch 1923.
*8. BARYCHELIDAE Pocock 1897.
9. MIGIDAE Pocock 1897.
*10. DIPLURIDAE Pocock 1897.
*11. CTENIZIDAE Thorell 1887.
12. ACTINOPODIDAE Pocock 1903.

Suborder—Labidognatha

Hypochiloidea

Family

13. GRADUNGULIDAE Forster 1955.

Neocribellatae

Family

*14. FILISTATIDAE Ausserer 1867.
*15. OECOBIIDAE Blackwall 1862.
*16. ERESIDAE Koch 1850.
17. DINOPIDAE Koch 1850.
*18. ULOBORIDAE Cambridge 1871.
*19. DICTYNIDAE Cambridge 1871.
*20. AMAUROBIIDAE Bertkau 1878.
*21. PSECHRIDAE Simon 1890.
22. TENGELLIDAE Dahl 1908.
23. ZOROPSIDAE Bertkau 1882.
24. ACANTHOCTENIDAE Cambridge 1902.

Ecribellatae

Haplogynae (Primitive hunters and weavers)

Family

25. SICARIIDAE Keyserling 1880.

*26. SCYTODIDAE Blackwall 1852.
*27. LOXOSCELIDAE Gertsch 1949.
28. DIGUETIDAE Gertsch 1949.
29. PLECTREURIDAE Banks 1898.
*30. CAPONIIDAE Simon 1890.
*31. OONOPIDAE Simon 1890.
32. TETRABLEMMIDAE Cambridge 1873.
33. OCHYROCERATIDAE Fage 1912.
34. LEPTONETIDAE Simon 1890.
35. TELEMIDAE Petrunkevitch 1923.
36. DYSDERIDAE Koch 1837.
37. SEGESTRIIDAE Petrunkevitch 1933.

Entelogynae

Trionycha (Higher web weavers)

Family
*38. PHOLCIDAE Koch 1850.
39. SYMPHYTOGNATHIDAE Hickman 1931.
*40. THERIDIIDAE Sundevall 1833.
41. NESTICIDAE Dahl 1926.
42. HADROTARSIDAE Thorell 1881.
*43. LINYPHIIDAE Blackwall 1859.
44. MICRYPHANTIDAE Bertkau 1872.
45. THERIDIOSOMATIDAE Vellard 1924.
*46. ARGIOPIDAE or ARANEIDAE Dahl 1912.
*47. TETRAGNATHIDAE Menge 1866.
*48. AGELENIDAE Koch 1837.
49. ARGYRONETIDAE Menge 1871.
50. DESIDAE Pocock 1895.
*51. HAHNIIDAE Bertkau 1878.

Three clawed hunters

Family
*52. HERSILIIDAE Thorell 1869.
*53. UROCTEIDAE Thorell 1869.
54. MIMETIDAE Simon 1890.
55. ARCHAEIDAE Koch 1854.
*56. ZODARIIDAE Thorell 1881.
57. PALPIMANIDAE Cambridge 1871.
*58. PISAURIDAE Simon 1890.
*59. LYCOSIDAE Sundevall 1833.
*60. OXYOPIDAE Thorell 1869.
61. SENOCULIDAE Simon 1890.
62. TOXOPIDAE Hickman 1940.

Dionycha (two clawed hunting spiders)

Family
63. AMMOXENIDAE Simon 1893.
*64. GNAPHOSIDAE Pocock 1898.
65. PRODIDOMIDAE Simon 1894.
*66. HOMALONYCHIDAE Petrunkevitch 1923.
67. CITHAERONIDAE Caporiacco 1937.
*68. CLUBIONIDAE Wagner 1888.
69. ANYPHAENIDAE Bertkau 1878.
70. AMAUROBIOIDIDAE Hickman 1949.
71. ZORIDAE Dahl 1912.
*72. CTENIDAE Keyserling 1876.
*73. SPARASSIDAE Bertkau 1872.
*74. HETEROPODIDAE Pocock 1896.
*75. SELENOPIDAE Cambridge 1900.
*76. PLATORIDAE Simon 1890.
*77. THOMISIDAE Sundevall 1833.
78. APHANTOCHILIDAE Thorell 1873.
*79. SALTICIDAE Blackwall 1841.
*80. LYSSOMANIDAE Banks 1892.

ILLUSTRATED KEY FOR IDENTIFYING THE FAMILIES OF COMMON INDIAN SPIDERS

1a. Chelicerae paraxial, i.e. projecting forward and fang articulated with chelicerae in a vertical plane and movable in a plane more or less parallel to the median plane of the body, fang closing backward (Figs. 11-14). With two pairs of book lungs (Figs. 15, 16) .... Suborder ORTHOGNATHA-2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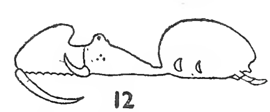
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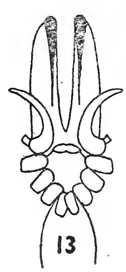
Figs. 11-12. Fang action in the Orthognatha, lateral view. (11) Fang closed. (12) Fang opened.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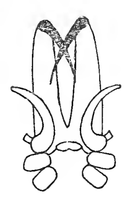
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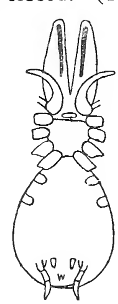
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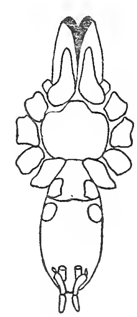
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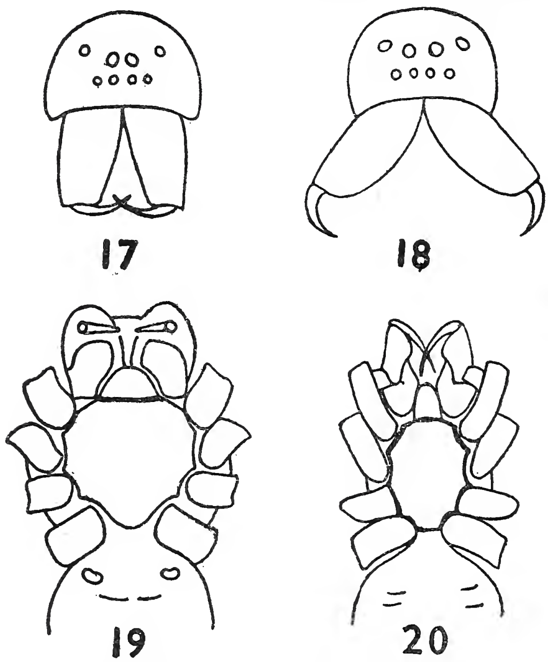
Figs. 13-14. Fang action in the Orthognatha, front view. (13) Fang closed. (14) Fang opened.

Figs. 15-16. Ventral view of Labidognatha. (15) *Calommata fulvipes* (16) *Atypus niger.*

1b. Chelicerae diaxial, i.e. projecting downward and fang articulated with chelicerae in a horizontal plane and movable in a more or less transverse plane (Figs. 17-20). Commonly with one pair of

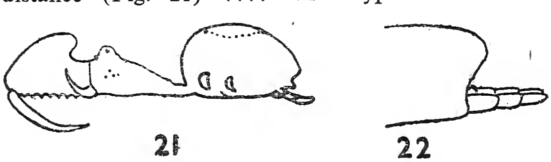
book lungs (Fig. 46) .. Suborder LABIDOGNATHA-7

2a. Abdomen with one to nine sclerotized tergites (Fig. 21). Furrow of cheliceral fang indistinct.



Figs. 17-20. Fang action in the Labidognatha. (17) Closed. (18) Opened. (19) *Ctenium banksi*. (20) *Dysdera crocata*.

Anal tubercle not immediately behind spinnerets, but separated from the spinnerets by considerable distance (Fig. 21) .... The atypical tarantulas-3



Figs. 21-22. (21) Lateral view of *Calommata fulvipes* female. (22) Spinnerets and tubercle.

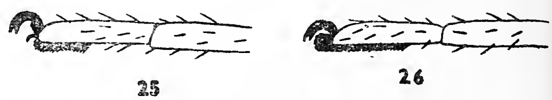
2b. Abdomen without sclerotized tergites. Anal tubercle immediately behind the four spinnerets (Fig. 22). Furrow of cheliceral fang distinct. .... Typical tarantula-4.

3a. Abdomen furnished with nine distinct tergites. Maxillae normal. Eight spinnerets situated in the lower middle of abdomen. (Fig. 24). .... Family LIPHISTIIDAE

3b. Abdomen not furnished with distinct tergites. Maxillae strongly developed and labium fused with sternum (Fig. 16). Six spinnerets, situated in the

Figs. 23-24. (23) Cephalothorax and abdomen of the Mygalomorphae. (24) Cephalothorax and abdomen of the *Liphistius*.

lower end of abdomen. (Fig. 23) .... Family ATYPIDAE



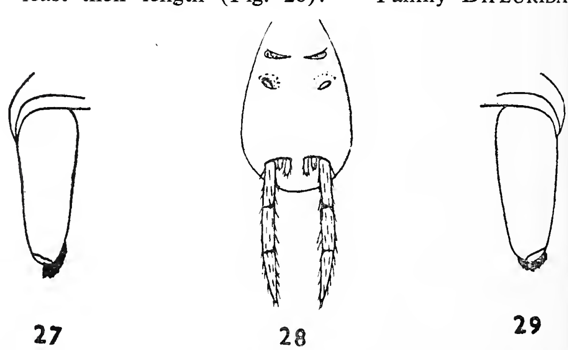
Figs. 25-26. Showing scopulae and claw tufts of Theraphosidae.

4a. Tarsi with a small median (a) as well as two large lateral claws, and without claw tufts (Fig. 25) 5

4b. Tarsi with only two claws and with claw tufts (Fig. 26) .... Family THERAPHOSIDAE

5a. Chelicerae with a rastellum (Figs. 27, 29). Posterior spinnerets short or moderately long, anterior spinnerets close together at base 6

5b. Chelicerae without rastellum. Posterior spinnerets very long, anterior spinnerets separated by at least their length (Fig. 28). Family DIPLURIDAE



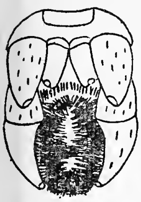
Figs. 27-29. (27 & 29) Showing rastellum of chelicera. (28) Ventral view of abdomen of Dipluridae.

6a. Head region much higher than the thoracic region. Tarsi without ungual tufts. .... Family CTENIZIDAE

6b. Head region not much higher than the tho-

racic region. Tarsi with distinct ungual tufts...... .... Family BARYCHELIDAE

7a. With a cribellum in front of spinnerets (Figs. 30-32) and a calamistrum on metatarsus IV, varying from just a few bristles to a row the entire length of the metatarsus (Fig. 33) .... Section CRIBELLATAE-8



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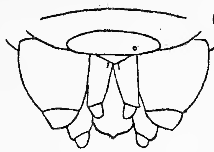

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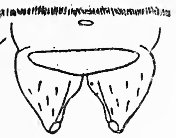

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Figs. 30-32. (30) Showing spinnerets and cribellum of *Oecobius*. (31) Showing spinnerets and cribellum of *Hyptiotes*. (32) Showing spinnerets and cribellum of *Amaurobius*.

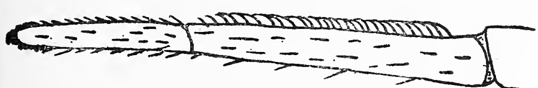

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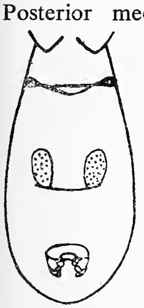
Fig. 33. *Dictyna* calamistrum.

7b. Without a cribellum and calamistrum. .... Section ECRIBELLATAE-15

8a. With two pairs of lungs (Fig. 34) .... Family HYPOCHILIDAE

8b. With only one pair of lungs. 9

9a. Anal tubercle large and prominent, two segmented with a fringe of long hairs (a) (Fig. 35). Posterior median eyes triangular or irregular in



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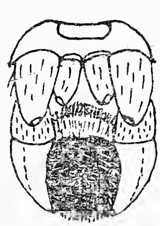

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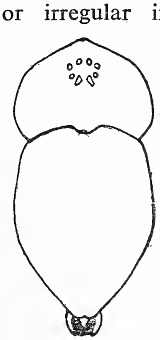

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Figs. 34-36. (34) Ventral view of *Hypochilus*. (35) Ventral view of *Oecobius*. (36) Dorsal view of *Oecobius*.

shape. Small spiders 2 to 2.50 mm long with carapace sub-circular (Fig. 36). .... Family OECOBIIDAE

9b. Anal tubercle of the usual type, without a conspicuous fringe of hairs. Posterior median eyes circular. 10

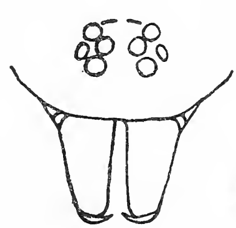
10a. Head region large, rounded, high, posterior lateral eyes remote from the rest. Family ERESIDAE

10b. Head low, narrowed, posterior lateral eyes very rarely remote from the others. 11

11a. Tarsi furnished with ungual tufts and an inferior claw .... Family PSECHRIDAE

11b. Tarsi without ungual tufts and inferior claw 12

12a. Chelicerae fused together at the base. (Fig. 37). Labium fused to the sternum (Fig. 38). Tracheal spiracle considerably in advance of the spinnerets. Calamistrum short (Fig. 39) .... Family FILISTATIDAE



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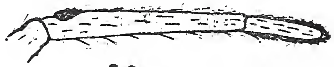
Figs. 37-38. (37) Front view of *Filistata*. (38) Ventral view of *Filistata*.

12b. Chelicerae not fused at base. Labium free. Tracheal spiracle in the usual position close to the spinnerets. Calamistrum much longer (Fig. 40) 13

13a. Tarsi with a dorsal row of trichobothria. Eight eyes all light in colour, homogeneous.

.... Family AMAUROBIDAE

13b. Tarsi either without trichobothria, Eight eyes, either all dark or eyes heterogeneous. 14



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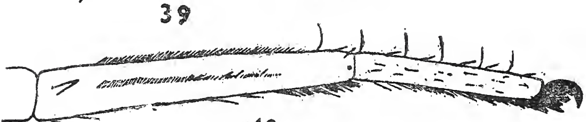

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Figs. 39-40. (39) *Amaurobius,* IV leg showing calamistrum and trichobothria. (40) *Filistata,* IV leg showing calamistrum.

14a. Eyes eight, homogeneous, dark, both rows recurved. Metatarsus IV compressed and concave above (Fig. 41). .... Family ULOBORIDAE

14b. Eyes eight heterogeneous, the anterior medians alone dark, Metatarsus IV of the usual shape. .... Family DICTYNIDAE

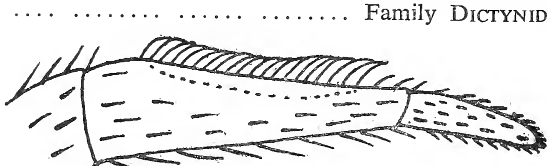

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Fig. 41. *Hyptiotes,* IV leg showing calamistrum.

15a. Tibia and metatarsus I and II with a prolateral row of long spines, in the intervals between which is a row of much shorter spines, curved near their ends and increasing in length distally (Fig. 42) .... Family MIMETIDAE

42

Fig. 42. *Mimetus,* metatarsus I showing spination.

15b. Tibia and metatarsus I and II without spines or spine arrangement not as illustrated in (Fig. 42). 16

16a. Sternum much wider than long, the posterior coxae widely separated. (Fig. 43). .... Family PLATORIDAE

16b. Sternum not wider than long, posterior coxae not widely separated. 17

17a. Posterior spinnerets absent or much shorter than the anterior. .... Family ZODARIIDAE

17b. Posterior spinnerets present, not shorter than anterior 18

18a. Posterior spinnerets enormously long, usually longer than the abdomen (Fig. 44). .... Family HERSILIIDAE

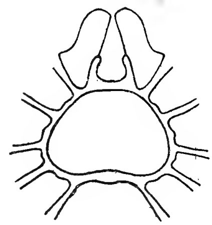

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Fig. 43. *Plator,* showing sternum.
Fig. 44. Abdomen with spinnerets of Hersiliidae.

18b. Posterior spinnerets shorter and thick .. 19

19a. Anal tubercle very large, fringed with long hairs, ocular group compact. .. Family UROCTEIDAE

19b. Anal tubercle small, not fringed, ocular group not compact 20

20a. Tarsi long and flexible. Labium broader than long, legs very long and slender. .... Family PHOLCIDAE

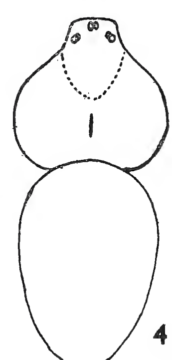
20b. Tarsi of the usual type. Labium longer than wide. 21

21a. With less than eight eyes. 22

21b. With eight eyes. 25

22a. Eyes six in three groups. 23

22b. Eyes six in one group. 24



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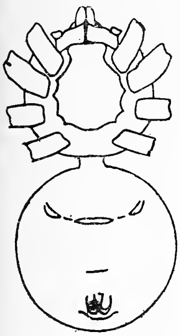
Figs. 45-46. Dorsal view of *Loxosceles.* (46) Ventral view of *Loxosceles.*

23a. Carapace round and high behind, sternum round behind. (Figs. 47-48). .. Family SCYTODIDAE

23b. Carapace flat and depressed. Sternum pointed behind. (Figs. 45, 46). .. Family LOXOSCELIDAE

24a. Very small spiders 1 to 3 mm long. Labium as wide as long. Median eyes larger than the laterals. (Fig. 49). .... Family OONOPIDAE



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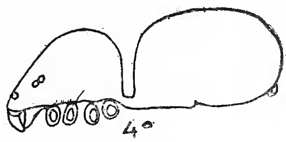

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Figs. 47-48. (47) Ventral view of *Scytodes*. (48) Lateral view of *Scytodes*.

24b. Small but larger than Oonopidae, eyes two, or four or six in number (Figs. 50, 51). Epigastric furrow far behind the normal region. .... Family CAPONIIDAE

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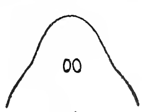

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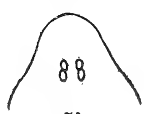

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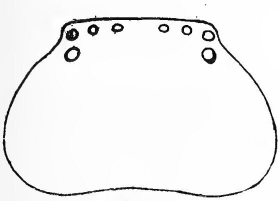
Fig. 49. Eyes of Oonopidae.
Figs. 50-51. Eyes of Caponiidae.

25a. Anterior row with six eyes (Figs. 52, 53). .... Family SELENOPIDAE



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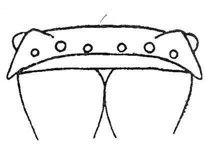

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Figs. 52-53. Eyes of Selenopidae. (52) Dorsal view. (53) Front view.

25b. Anterior row with four or two eyes 26

26a. Tarsi with two claws, with claw tufts... 27

26b. Tarsi with three claws, without claw tufts. 37

27a. Tarsal claws without teeth (Fig. 54). ....

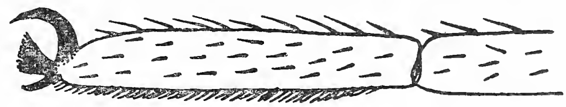

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Fig. 54. *Homalonychus,* tarsus.

.... Family HOMALONYCHIDAE

27b. Tarsal claws with usual teeth 28

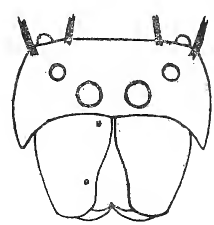
28a. Eyes in three or four rows. 29

28b. Eyes in the more common arrangement of two rows. 32

29a. Eyes in four rows, the front very large (Fig. 56). .... Family LYSSOMANIDAE

29b. Eyes in three rows 30

30a. Front row of eyes more or less vertical face; median eyes enormously large, (Fig. 55), second row of two very small, often minute, third row of two eyes of medium size. Family SALTICIDAE



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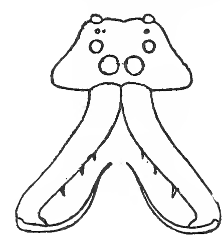

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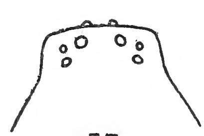
Figs. 55-56. (55) *Phidippus,* carapace from the front. (56) *Lyssomanes,* carapace front view.

30b. Front row of eyes not vertical, and eyes of this row smaller than those of the second. 31

31a. First row of two eyes, second row with four and third row with two. (Figs. 57, 58). Anterior



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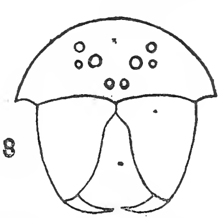

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Figs. 57-58. (57) *Ctenus,* showing eyes from above. (58) *Ctenus,* showing eyes from front.

lateral much closer to the posterior laterals than to the anterior medians. Retromargin of cheliceral fang furrow with at least three teeth. Family CTENIDAE

31b. First row with four eyes, second and third row each with two (Fig. 59). Anterior laterals much closer to anterior medians than to the posterior laterals. Retromargin of cheliceral fang furrow with two teeth. .... Family ZORIDAE

32a. Tracheal spiracle in advance of the spinnerets at least one-third of the distance betweeen the latter and epigastric furrow (Fig. 60). .... Family ANYPHAENIDAE

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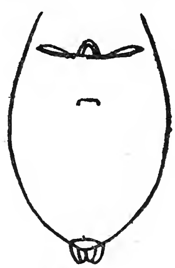

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Figs. 59-60. (59) Showing the eyes of Zoridae. (60) Showing the ventral view of abdomen of Anyphaenidae.

32b. Tracheal spiracle in the usual place just in front of spinnerets. 33

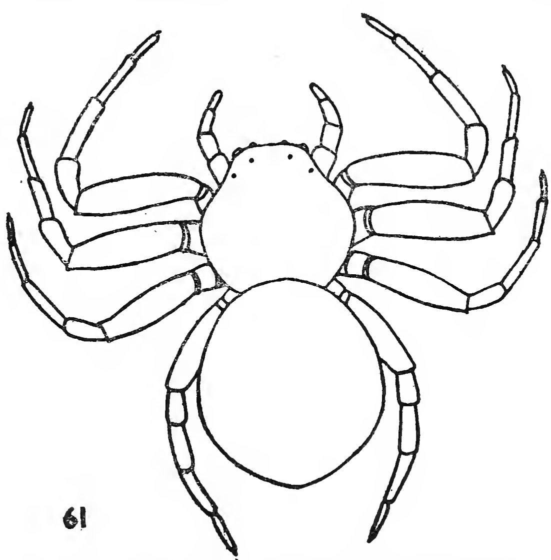

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Fig. 61. Crab-spider showing laterigrade legs.

33a. Legs at least I and II laterigrade, crab-like (Fig. 61). 34

33b. Legs all usual prograde type 36

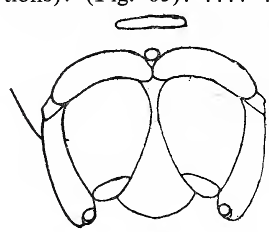
34a. Colulus absent. Retromargin of cheliceral fang furrow armed with teeth. 35

34b. Colulus present (Fig. 62). Retromargin of cheliceral fang furrow smooth. Family THOMISIDAE

35a. Cephalothorax as long as wide. Posterior row of eyes recurved, anterior row straight or procurved, lateral eyes larger. Apex of metatarsus with a soft trilobate (Fig. 64). .. Family HETEROPODIDAE

35b. Cephalothorax as long as wide or slightly longer than wide. Posterior row of eyes straight or slightly procurved, anterior row usually straight and subequal, lateral not larger than medians. .... Family SPARASSIDAE

36a. Anterior spinnerets conical, contiguous. Maxillae without a transverse or oblique depression. Eyes homogeneous or almost so (with few exceptions). (Fig. 63). .... Family CLUBIONIDAE



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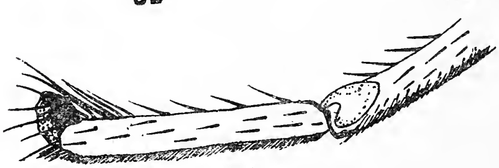


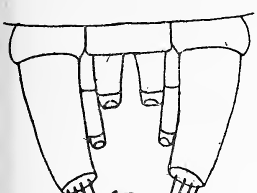
64

Figs. 62-64. (62) *Xysticus*, spinnerets and colulus. (63) *Clubiona* spinnerets. (64) *Heteropoda* leg, metatarsus and tarsus.

36b. Anterior spinnerets cylindrical, and separated by a distance about equal to the diameter of one (Fig. 65). Maxillae with an oblique depression. (Fig. 66). Eyes distinctly heterogeneous, the anterior medians dark; the posterior medians often oblique, oval, or triangular. .. Family GNAPHOSIDAE

37a. The six spinnerets in a more or less transverse row (Fig. 67). Tracheal spiracle removed from the spinnerets at least one third of the distance to epigastric furrow. .... Family HAHNIIDAE

37b. Spinnerets not so placed, but of the usual arrangement. Tracheal spiracle in the usual place in front of the spinnerets. 38



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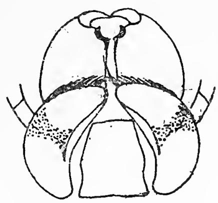

66

Figs. 65-66. (65) *Gnaphosa,* spinnerets. (66) *Gnaphosa* showing maxillae and labium.

38a. Eye groups hexagonal, the posterior row procurved, and anterior row recurved, with the clypeus high (Fig. 68). Abdomen pointed behind and legs with very conspicuous spines. .... Family OXYOPIDAE

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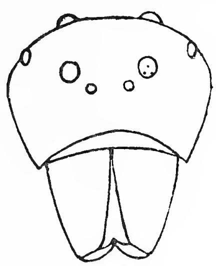

68

Figs. 67-68. (67) Showing spinnerets of Hahniidae. (68) Showing eyes of *Oxyopes.*

38b. Eye groups not forming a hexagon, and clypeus much lower. 39

39a. Tarsus IV with, in most specimens provided for at least one sixth its length from the distal end with a ventral row of 6 to 10 serrated bristles, forming a comb (Fig. 69) which may be poorly developed in males. Spiders hanging in an inverted position in irregular mesh webs. .. Family THERIDIIDAE

39b. Tarsus IV without such combs. 40

40a. Tarsi with trichobothria (Fig. 70) 41

40b. Tarsi without trichobothria. 45

41a. Tarsi with single row of trichobothria (Fig. 71). Trochanters not notched, most species living in sheet webs with a funnel, over which they run rapidly in an upright position. .. Family AGELENIDAE

41b. Tarsi with numerous trichobothria, but irregularly distributed (Fig. 69). All trochanters with a curved notch. 42

42a. Posterior row of eyes so strongly recurved that it may be considered to form two rows (Fig. 73). Median claw smooth or with a single tooth. Anterior piece of lorum (a) rounded behind and fitting into a notch of the posterior piece (Fig. 72). Egg sac carried attached to spinnerets and young carried on mother's back. .... Family LYCOSIDAE

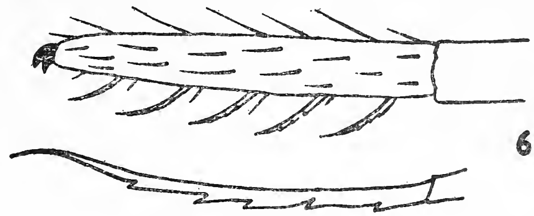

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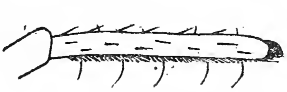
Fig. 69. *Theridion,* tarsus IV showing comb of serrated bristles.



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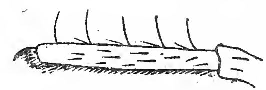

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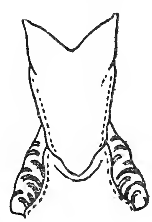
Figs. 70-71. *Lycosa,* tarsus showing trichobothria.



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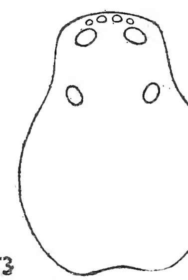

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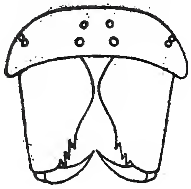
Figs. 72-73. (72) *Lycosa* lorum of pedicel. (73) Showing eyes of *Lycosa.*

42b. Posterior row of eyes not forming two distinct rows, but only slightly recurved. Median claw with two or three teeth. Anterior pieces of lorum with a notch into which the posterior piece fits. Egg sac held under cephalothorax. Young not carried by mother. .... Family PISAURIDAE

43a. Clypeus in most lower than the height of the median ocular area (Fig. 74). Eyes homogeneous (Most are orb weavers). 44

43b. Clypeus usually as high as or more commonly higher than, height of the median ocular

area (Fig. 75). Eyes heterogeneous (The majority are not orb weavers). 45



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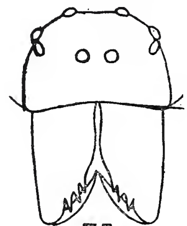

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Figs. 74-75. (74) *Araneus*, face and chelicerae. (75) *Pityohyphantes*, face and chelicerae.

44a. Epigastric furrow between lung slits procurved (Fig. 76). No boss on chelicerae. In most cases the chelicerae are large and powerful (Fig. 77). .... Family TETRAGNATHIDAE

44b. Epigastric furrow nearly straight. Boss present on chelicerae (Fig. 78) though rudimentary in some cases. (True orb weavers). .... Family ARGIOPIDAE or ARANEIDAE

45a. Tibia of male pedipalp without apophyses (though the tibia may be dilated distally). (Fig. 79). Palp of female in most species with a claw at the end of the tarsus. Tibia IV in most species with two dorsal spines, or if only one spine is present then there is one short spine on metatarsi I and II. .... Family LINYPHIDAE

45b. Tibia of male pedipalp in most species with at least one apophysis (Fig. 80). Palp of female without a claw at end of tarsus. Tibia IV with a single dorsal spine or bristles and with the metatarsi spineless. .... Family MICRYPHANTIDAE

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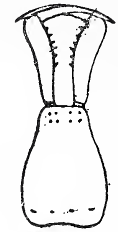

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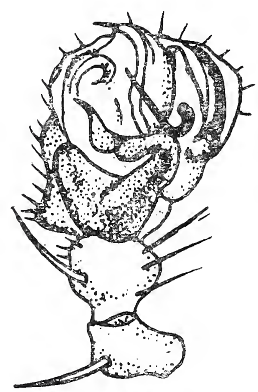
Figs. 76-78. (76) *Tetragnatha* ventral view of abdomen and showing procurved epigastric furrow. (77) *Tetragnatha* showing body and chelicerae. (78) Lateral view of cephalothorax of *Araneus* showing boss.



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Figs. 79-80. (79) Male palp of *Lepthyphantes*. (80) Male palp of *Ceraticelus* with tibial apophysis.

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The following represent the few works in English, that give general information about spiders or assist in further identification of at least some groups.

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LEVI, H. W. & L. R. (1968): Spiders and their Kin, New York.

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Reviews

1. FUNCTION AND EVOLUTION IN BEHAVIOUR: Essays in Honour of Professor Niko Tinbergen, F.R.S. Edited by Gerard Baerends, Colin Beer and Aubrey Manning. pp. xxxii + 394 (24 × 16 cm), with 7 black-and-white plates and many illustrations. London, 1975. Oxford University Press. Price £ 16.50.

The origins of this volume are made clear in a dedication and introduction: it is a set of essays written mainly by former students and close associates of Professor Tinbergen, prepared for presentation to him on his retirement from the Chair of Animal Behaviour at the University of Oxford. The editors tell us that they called for contributions on the major theme of 'the functions and evolution of animal behaviour', subjects which they note have been at the heart of the studies of 'a Grand Master of Ethology' during his time at Oxford. The editors' introduction describes the development of Professor Tinbergen's work, beginning with his vigorously intellectual upbringing in Holland and going on to show how greatly he influenced those who studied under him, first at Leiden University, then at Oxford. This introduction is followed by a useful bibliography of Tinbergen's works.

The functions and evolution of the book are less clear than its origins. The editors apparently started with a four-part plan. There was to be a major division between contributions treating the evolutionary history of behaviour patterns and those dealing with the survival-value of particular behaviours. Each of these major divisions was to be divided into a general theoretical section and a section dealing with particular pieces of research. However, we are told that the essays received did not fit well into this scheme and instead the editors decided to arrange the contributions according to whether they dealt primarily with the function of behaviour or whether they relied mainly on comparative method to make their points. Within these two parts the essays have been grouped to lead from the general conceptual statement to the account of a detailed piece of research. The editors themselves admit that some of the 'functional' essays are concerned with work that relies heavily on comparisons, while it is found that some of the contributions in the comparative section concern themselves largely with the functions of the behaviours which are compared. So the division of the book is not straightforward, nor is it, one feels, particularly useful: it does not read easily from beginning to end. This lack of clear structure is one aspect of a general fault: the book does not appear to have had strong editorial direction. Perhaps this is to be expected when three editors residing in separate countries are involved.

It is impossible to treat all the many contributions to this volume in any detail here, but it may be useful to the potential reader to record, in order of appearance, the impressive list of contributors together with an ab-

breviated version of their essay titles: Hinde (Cambridge)—Concept of Function; Beer (Rutgers)—Multiple Functions and Gull Displays; Roeder (Tufts)—Feedback and Spontaneous Activity; Manning (Edinburgh)—Behaviour Genetics; Liley (British Columbia) and Seghers (Manitoba)—Guppy Morphology; Kruuk (Banchory)—Carnivore Social Hunting; van Iersel (Leiden)—Orientation of *Bembix;* Patterson (Culterty)—Rook Aggression; Baerends (Groningen)—Conflict; Lindauer (Würzburg)—Orientation and Learning; Immelmann (Bielefeld)—Early Experience; Marler (Rockefeller)—Behavioural Development; Moynihan (Smithsonian, Panama)—Conservatism in Cephalopod Display; Robinson (Smithsonian, Panama)—Araneid Spider Predation; Nelson (Aberdeen)—Sulid Behaviour McKinney (Minnesota)—Duck Display; Tschanz and Hirsbrunner-Scharf (Bern)—Adaptations of Guillemot and Razorbill Chicks.

This is certainly not a book for the general reader (who would not be alone in stumbling over such headings as: 'Trans-Modality Transposing of Menotactically Maintained Angles of Orientation'), nor is it well suited to the biologist who is not a specialist ethologist. One feels that while some of the contributions will be of interest to many working in the now very broad fields of ethology and ecology, the book as a whole will be fully appreciated by only a limited audience. (It will no doubt be greatly appreciated by Professor Tinbergen himself, but in printing the book the publishers presumably have a more extensive audience in mind). The dust-jacket states that the authors endeavour to trace the development of concepts 'towards a synthesis with other branches of behavioural research'. Whatever that may mean, a strong feeling of synthesis does not appear as one goes through the volume, and no attempt at a synthesis is made by the editors. Instead, one has a set of rather disparate contributions, ranging from straightforward reports of research on one species or one small group of animals to purely conceptual essays. Not all the contributions are strictly within the set bounds of the book: Liley and Seghers confine themselves almost entirely to the evolution of growth rate and body size, for instance. Most of the essays are written in highly technical language. This is a pity, since one of major factors in Tinbergen's influence, as is pointed out in the introduction, has been his ability to speak and write simply and clearly, allowing him to carry ethology and the fascination of animal behaviour to the general public. Although the sheer variety of the material presented in this book is a tribute to the multiple stimuli given by Tinbergen, one feels that the editors have not made a sufficient effort to present this variety to a public audience in a digestible form.

However, though the meal as a whole may be somewhat indigestible, different readers will find satisfaction in different particular courses. This reviewer found the contributions of Kruuk, Marler and Moynihan to be of especial interest. Kruuk directly relates differences in the social behaviour of carnivores (emphasizing the hunting behaviour of hyaenas) to differences in diet and habitat, and he gives some thought to the relevance of his findings to aspects of human behaviour. The essay is readable, interesting, and directly concerned with the title of the book. Marler's contribution stresses the need for caution in labelling behaviour as innate or acquired. He shows, by referring to an elegant series of birdsong studies, how an adult behaviour pattern can result from the complex interaction, during development, of experience with a built-in 'template'. He also comments on the relevance of his work to theories on the origin of human

language (in their introduction, the editors note that contributions dealing specifically with human ethology, one of Tinbergen's most recent interests, are unfortunately absent from this volume). Moynihan presents a convincing hypothesis to explain the persistence for more than 190 million years of some cryptic and alarming displays amongst cephalopods. Conservatism in alarming displays may have resulted from the wide diversity of display receivers likely to have been present throughout this period.

Even in these contributions there are some grounds for criticizing the editors. In a work such as this, inevitably concerned heavily with conceptual problems, the careful definition of terms assumes considerable importance. But in this direction a lack of rigour is again evident. For example, having defined 'hunting' as 'the pattern of activities adapted to the capturing of other animals', Kruuk states that it is 'virtually absent in other orders of mammals (except in man), ungulates, and rodents, with the exception of insectivores'. A moment's thought tells one that there are as many mammalian orders containing carnivores and insectivores (i.e. predators) as there are containing herbivores. One thinks of monotremes, marsupials, bats, edentates and pangolins, whales and the many insectivorous and omnivorous primates. Although Kruuk includes the termite-eating aardwolf in his account, one feels that for 'hunting' he usually has in mind the capture of vertebrate prey; in his discussion he introduces 'foraging' to cover the broader subject he treats.

One last minor criticism also concerns editorial control. The book carries three indices (species, author and subject) covering 12 pages. Several species (such as gazelle, kittiwake and zebra) are listed in both species and subject indices and sometimes given more page references in one than the other, while not all the pages on which they appear are listed (zebra, p. 123). One-word species-names appear throughout with their initial letter in lower-case type, while any species whose common name contains an adjective has the initial letter in upper-case. This is irritating, especially when a list of species contains both types of name. Surely rook is no less a proper name than Snow Goose?

Despite these criticisms, it must be said that the volume contains a great deal of important material, some of which will be required reading for those engaged in ethological and eco-ethological research. The standard of production is high and there are relatively few typographical errors. But it is a pity that a greater effort could not have been made to produce a more strongly-integrated book with a wider appeal. The price alone (£ 16.50) will reduce the size of its audience, yet when a large amount of money is being spent one expects to find that some effort has gone into the planning and editing of a book.

J.F.O.

2. A PUNCHED CARD KEY TO THE DICOT FAMILIES OF SOUTH INDIA. By Cecil J. Saldanha and C. Kameswara Rao. pp. 18 + Cards A-Y and 1-51. Bangalore, 1975. Centre for Taxonomic Studies, St. Joseph's College. Price Rs. 35.00.

This is the first attempt to prepare a punched-card-key for the identification of families of plants in India. One, not familiar with the use of punch-card-keys of this type, gets a pleasant surprise on using it. This reviewer has used it several times with great satisfaction. Repeated use by others will bring to focus its true values. The cost of the index is not within reach of an average graduate student of Botany but its popularity will perhaps result in lowering its price. The authors are to be congratulated for publishing this valuable taxonomic tool in the service of botanists and others wanting to classify plants.

P.V.B.

3. RODENTS OF ECONOMIC IMPORTANCE IN INDIA. By S. A. Barnett and Ishwar Prakash. pp. xii + 176 (22 × 14.5 cm), with 14 plates and 41 text-figures. New Delhi, 1975. Arnold-Heinemann. Price Rs. 35.00.

The authors rightly emphasise that no matching research efforts have been made on rodents considering their damage potential to food grains. In contrast, intensive efforts are made on insect pests like locusts. The accumulated literature on rodents is however concerned largely with public health importance and transmission of a variety of diseases. Need for the creation of vertebrate biology department in Agricultural Universities has been rightly pointed out and a co-ordinated re-orientation of courses in biology is very essential to provide the perspective training.

In the second chapter, the reproduction aspects have been detailed. But use of chemosterilants for possible control of rodents should have been dealt with in greater detail and deserve a place in the chapter along with acute poisons, anticoagulants etc. Much more work has been done on synthetic oestrogen reproduction inhibitor 'BDH 10131'. In growth section, the investigations of Spillett (1966) on three species of rats are not referred. In fact, it would have been appropriate, to present Spillett's data on its entirety. In population Dynamics, the extrinsic factors like food, disease and intrinsic factors such as social interactions have been well detailed. Some references to the investigations of DeLong (1967) on population ecology of feral house-mouse, and Calhoun's (1962), would have imparted more information on these aspects of rodents. In feeding and exploratory behaviour, more information on new object reactions and Rzoaka's (1953) work on baits shyness would have been a welcome addition.

The third chapter deals with the principles of control. The authors rightly advocate measures like prevention of entry through proofing measures, reduced fertility, use of poisons to minimise the population and encouragement of natural predators.

The fourth chapter deals with the analysis of losses. The authors substantiated their opinion in the introductory chapter that knowledge of statistics is essential to a Biologist to

conclude the meaningful estimates of the damage caused by the rodents.

Chapter 5 deals with methods of control. More information on zinc phosphide and role of brass material used in the baits for ultimate acceptance by rats is desirable. Other conventional acute poisons like Thallium Sulphate are concisely mentioned since they are not in popular use. Anticoagulants are being preferred increasingly in the rodent control programmes in India and are the preferred rodenticides in Western Countries. Therefore, more details and better treatment to this class of rodenticides is essential. Warfarin is effective to *Rattus rattus* at 0.025 per cent concentration including *Mus musculus* and Diphacinone has no special advantage as such. Anticoagulants have been successfully tried in sugarcane, jowar and wheat fields. Aluminium phosphide can be used successfully not only during monsoon and in irrigated fields, but also in other climatic conditions. Only precaution to be taken is to create humid condition by using a little water in the burrows before use. It is not flammable by itself and such situation can exist only when it comes in contact with liquid water. The authors should have gone to the depth of the various characteristics of the chemicals used in rodent control work. Other aspects like environmental control are interesting.

Principal species are dealt in chapter 6. Adequate details are given which help to plan control strategies. Chapter 7 gives essential information on research which will be particularly interesting for a fresh student in rodent control investigations.

The book is a welcome addition to the literature on Indian rodents. There is a definite derth on literature that deals with economic rodent species highlighting their role as agricultural pests.

H.N.M.R.

4. TAXONOMY OF INDIAN MOSSES. By R. S. Chopra. pp. xl + 631 (24 × 16 cm), with 122 text-figures and a map. New Delhi, 1975. Publication & Information Directorate, (CSIR). Price Rs. 96.00, $ 38.00, £ 15.00.

This publication indeed fulfils a long-felt need of a comprehensive taxonomic account of the Moss flora occurring in the Indian subcontinent (India, Pakistan, Nepal, Bhutan, Western & S.E. Tibet).

It reviews and brings together all the Taxonomic information on the moss flora of the region since 1808 when the first paper on Nepal mosses collected by Buchanan-Hamilton at the end of the 18th Century was published by William J. Hooker. About 328 genera and over 1200 species of Mosses have been classified in this volume. The author has deffered consideration of the following moss genera (which are in a confused state and a satisfactory treatment would be possible only when all the species reported from all over the world can be studied in the form of monographs). *Fissidens*, *Anisothecium-Dicrenella-Microdus* complex, *Campilopus*, *Calymperes*, *Hypophila*, *Pohlia*, *Brachymenium*, *Bryum*, *Orthotrichum*, *Macromitrium*, *Pterobryopsis*, *Calyptothecium*, *Daltonia*, *Thuidium*, *Symphyodon*, *Brachythecium*, *Rhyncostegium*, *Entodon*, *Clastobryum*, *Brotherella*, *Acroporium*, *Hypnum* and *Ectropothecium*.

The author has studied majority of collections of Indian Mosses in India and abroad,

and has consulted monographers and other authorities on taxonomic studies in support of his contentions regarding the status of several taxa.

This CSIR Botanical Monograph No. 10 is the largest in the series and perhaps the best of the Moss floristic works of India so far.

The book contains a conceptus of classes, orders, families and genera which are also described and keys upto species level are provided. A glossary of terms used is appended in 15 pages. Bibliography of 33 pages and an alphabetical index are also included. All in all this work fulfils the need of a comprehensive work on the Moss flora of the Indian subcontinent.

The author deserves the thanks of Bryologists of India and abroad for presenting this important work for teaching and research purposes. The publication and Information Directorate deserves compliments for the production values of such a complicated work so ably executed. It compares well with any standard taxonomic work in any part of the world.

P.V.B.

5. THE INDIGENOUS TREES OF THE HAWAIIAN ISLANDS. By Joseph F. Rock. 2nd edition. pp. xx + 548 (26 × 18.5 cm), with 215 photographic plates. Tokyo, 1974. Charles E. Tuttle Company. Price $ 22.50.

Hawaii is today an extraordinary blending of the new and the old, the endemic and the exotic. In order to truly appreciate these islands, the naturalist as well as the anthropologist has to unravel the many threads that go to make its many-splendoured fabric of life. Joseph F. Rock's work, first published in a limited edition in 1913 and now re-edited for a wider public, is an important contribution to the understanding of the indigenous elements that have gone to make up the present-day flora of these bewitching islands.

The Pacific Tropical Botanical Garden has done a good service to Botany by undertaking the reprinting of Dr. Rock's original book. A striking feature of this work is a set of 215 revealing black and white photographs taken by Dr. Rock. They form a portrait gallery of the best of the indigenous Hawaiian plants. The reader is also given a general description of the vegetation of the Hawaiian Islands in the first 87 pages. The body of the book consists of a systematic treatment of the families of ferns, monocots and dicots indigenous to Hawaii. Several of the plants are endemic and not a few were new to science when first described in the original edition.

The second edition contains an appendix by Derral Herbst updating Rock's nomenclature. Not the least interesting part of the book is the introduction by Sherwin Carlquist who indicates the importance of this work to plant geographers trying to understand the origin and evolution of vegetation in isolated oceanic island groups.

A good book for the Hawaiian Naturalist and an interesting acquisition for the Botanist interested in insular vegetation.

C.J.S.

6. INDIAN SCIENCE INDEX 1975. Edited by Satyaprakash. pp. xvi + 140 (25 × 18 cm). Gurgaon/New Delhi, 1976. Indian Documentation Service. Price Rs. 50.00.

This volume of the *Indian Science Index* is the beginning of an attempt at collecting articles, research papers and notes, conference/seminar/symposia proceedings and transactions of societies in the form of a subject index. Its aim is a 'bibliographical control' of the growing volume of scientific knowledge, and its purpose is to make this knowledge available to workers in various scientific disciplines. The present publication deals with over 6000 articles classified under various headings and subheadings. Going over the list of journals and periodicals whence these articles are taken from, one feels that the index is by no means an exhaustive one. The omission of such outstanding journals as the *Records of the Zoological Survey of India, The Indian Forest Records,* the *Proceedings of the Indian National Academy,* and the *Journal of the Bombay Natural History Society,* to mention a few, leaves much to be desired. However, the thought that this is the first annual and is just a beginning, makes one to feel that the numbers which follow would be exhaustive ones. The price of Rs. 50/-, however, is very much on the high side and is beyond the reach of students and individual research workers.

J.S.S.

7. CHECKLIST OF THE BIRDS OF MAHARASHTRA WITH NOTES ON THEIR STATUS AROUND BOMBAY. By Humayun Abdulali. pp. ii + 16 (20 × 14 cm). With a sketch map of Maharashtra State on the inside of the front cover. Bombay, 1973. Bombay Natural History Society. Price Rs. 2.50.

This CHECKLIST is a very welcome addition to the necessary prerequisites for any person interested in the avifauna of the Maharashtra State. The absence of such checklists greatly handicap even knowledgeable birdwatchers when birding for the first time in an area. A checklist therefore can provide the basis for serious work being started in a region. It is a pity we do not have such inexpensive lists for the various parts of the country.

Checklists can, however, have their utility greatly overstretched when they purport to cover an area as large as the Maharashtra State which has such very dissimilar climatic regions within its limits, such as the Konkan and the Deccan. The compiler, however, has anticipated possible criticism on this score by clearly indicating those species which are found only in the Deccan and those inhabiting the Konkan. The status comments refer to the rest with a qualification that these apply more specifically to the immediate vicinity of Bombay.

Anyone intending to birdwatch in Maharashtra and in particular in the Thana, Kolaba and Greater Bombay districts would find this CHECKLIST very handy, being prepared by a person who has an intimate knowledge of the natural history of the area and is an expert of acknowledged merit in the subject in his own rights. Any additions to this CHECKLIST would be worthy of recognition!

K.S.L.

Miscellaneous Notes

1. NOTES ON ANIMALS SEEN ON SALSETTE ISLAND AND AROUND BOMBAY

5th April 1931: On the path between Powai Lake and Vihar Lake, near the Pipe line at about 4.30 p.m. a leopard crossed the path about 50 yards ahead of me going towards the West. There were one or two occupied huts and he must have passed very close to them.

1st January 1933: While snipe shooting in the afternoon about 4 miles from Thana on the Ghodbunder Road, a man came and told me a leopard had killed a goat on the hill to the left of the Road. I only had my 12 bore with some No. 8 shot, but went with him and found the goat with a broken neck and deep tooth marks in the neck. I just had time to return to Bombay and get some SG cartridges, while the man rigged a machan and I sat up all night, but saw nothing. The next weekend I went out and had a goat tied up nearby, but nothing came either on the Saturday or Sunday night. I thought I would try once more the following weekend, and early on the Saturday evening about 5 p.m. I saw the leopard about 100 yards away on the hill looking down at me, but he must have seen me and never came near.

August 1933: On the path from Tulsi Lake to Gaimukh Bunder on the Thana Ghodbunder Road there was a sounder of about 20 wild pig, all sows and young ones. These were the only wild pigs I ever encountered on Salsette.

Between Gaimukh Bunder and Ghodbunder, where the road goes inland from the creek I occasionally saw peafowl and also spur fowl, and once I heard a jungle cock crowing in the early morning.

Easter 1934: Parol, Bassein District. A tiger killed a cow in the low hills on the border of the reserve forest about one mile from Parol. There were distinct and unmistakeable tiger pug marks in the nullah which leads to the Tansa River from the South. By the time I arrived on the scene the cow was half eaten and was pretty high, and although I had a pit dug (there was no suitable tree) and sat up all night, nothing came to the kill.

30th May 1935: I had been all day round Kanheri Peak and passed through the village of Tulsi on my way back to my car which was parked on the side road leading from the Thana Rd. to Vihar Lake. As I was walking along the east side of Tulsi Lake about 6 p.m. I heard the "sawing" of a leopard which appeared to come from the west side of the lake near the dam. I waited a few minutes and to my surprise, not one, but two leopards walked slowly across the dam from north to south and disappeared into the jungle.

1936-37: On numerous occasions I went after a leopard in the hills to the right of the Poona Road, a mile or two beyond Thana where the road skirts the creek. There was a small tank up on the hill not far from the Rest House. I eventually shot a small female in May 1937 after what must have been at least 30 nights spread over 2 years. I know many other

people tried for this particular animal, which was a menace to goats and even to cattle, And I believe that the same year a male was killed from the same tree. During the late 1920's and through the 1930s and indeed even as late as 1949 I saw small mugger at various times on the north side of Vihar lake. The biggest I would say would be 6 ft.

1938: There was a small tank about 1 mile north-west of Thana, and in June 1938 I saw a small animal in the hills above the tank at a range of about 75 yards. At first I thought it was a Muntjac, but the colour seemed to be wrong as it was a light grey brown instead of the reddish brown of a muntjac, and I wondered whether it was a four horned antelope. In fact I now think it must have been, for in 1948 when shooting in Reserved Forest to the right of the main Nasik Road, one of the party shot a male four horned antelope, and I am fairly certain that this was the species of the animal I saw earlier. It would be interesting to know if there are other records of four horned antelopes on Salsette.

X'mas 1948: When shooting in reserved forest about mile 48 near the Nasik Road we were beating for jungle fowl and peafowl when a tigress and two 3/4 grown cubs came right through and passed me about 40 yards away. She seemed quite unhurried and was less than 100 yards in front of the beaters who were making a lot of noise. On the same day I saw a nilgai bull and two cows, also a large sounder of wild pig.

A fortnight later at the same place I was charged by a very large wild sow. She looked very vicious. I hit her head on with both barrels of my 12 bore loaded with No. 6 shot and turned her. After about 200 yards she collapsed dead. She measured 33 in. at the shoulder and weighed 196 lbs. on the railway station weighing machine. She was an old beast and rather lean.

1949: I have no date, but it was just after the monsoon. After crossing on the ferry on the Old Nasik Road, and about a mile beyond the ferry I was exploring a nullah for butterflies when I came across a very clear set of tiger pug marks in damp sand. I am not sure how far this was from Bombay but probably 45 to 50 miles.

Incidentally I once saw two chital does on the Old Nasik Road but cannot remember the date except that it was 1928 or 1929, and I saw wild pigs on more than one occasion.

In the late 1920's I used to know one of the Engineers working on the electrification of the GIP Railway between Lonavla and Poona, and often went up to stay with him for weekends at Lonavla. He used to drop me at Wadgaon station from his rail trolley and I spent many days after blackbuck and chinkara. Blackbuck were fairly common in those days and I got two good heads of 22 in. and 21 in. and a good chinkara on one occasion I found I had shot two buck with one shot with my .355 Mannlicher, which was a great pity, but I never saw the second one, and certainly did not want to kill it.

Later I shot 2 leopards at Mangaon one of which was a very heavy male, which was said to be responsible for killing over 100 cows. When skinning him I found four lethal balls, eight buck shot and one rifle bullet in the carcass.

One other unexpected animal was a sloth bear killed in a beat near Wadgaon in 1928. I never saw one before or since in Western India.

The last occasion on which I had any contact with wild animals near Bombay was in March 1950 when I was after butterflies on Trombay. My wife and small son were with me and I parked the car under a tree near a

small culvert on the road to Trombay village. My wife remarked that there was a strong smell of cat, but I could not perceive it myself and went off into the hills. When I came back in the afternoon I heard a lot of shouting and saw some men carrying a goat which had obviously been killed by a leopard. It had deep tooth marks on the back of its neck, and the men said they had seen the leopard and had driven it off. On going back to the culvert I had a look and sure enough there were the pugmarks. The men said this was the second goat they had lost that week. Both had been killed while grazing at the bottom and to the north of the highest hill on Trombay, a few hundred yards from a small village which I think was named Wadhavi or something similar. One wonders how the leopard got to Trombay, unless he came down the road from Ghatkopar at night. Otherwise as far as I remember Trombay is surrounded by marshes.

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2. SOME NOTES ON THE BREEDING HABITS AND GROWTH OF THE MALAYAN GIANT SQUIRREL (*RATUFA BICOLOR*) IN CAPTIVITY

Acharjyo & Misra [1973: *J. Bombay nat. Hist. Soc.* *70*(2):375] reported on the birth of a female Malayan Giant Squirrel (*Ratufa bicolor*) young on 15th July 1972 at Nandankanan Biological Park, Orissa.

Further five births were recorded to the female of the same pair of Malayan Giant Squirrels in the same Park as follows: March, 1; April, 2; September, 1; and December, 1. The litter size was always one. There were 3 males

Table 1

Date of last parturition	Date of subsequent parturition	Inter-parturition interval in days	Remarks
15-vii-1972	8-iii-1973	235	The young of 15-vii-1972 died on 17-ix-1972.
8-iii-1973	20-iv-1974	407	The young of 8-iii-1973 is living till the time of this report.
20-iv-1974	13-ix-1974	145	The young of 20-iv-1974 died on 21-iv-1974.
13-ix-1974	17-xii-1974	94	The young of 13-ix-1974 died on 15-ix-1974.
17-xii-1974	19-iv-1975	122	The young of 17-xii-1974 died on 19-xii-1974.

and 2 females. The eyes of all the young were closed at birth and the eyes of one young under observation opened on the 27th day.

At birth the young weighed 58 to 89 gm with a mean of 74.5 gm and measured 25.5 to 29.5 cm with a mean of 27.3 cm including tail lengths of 11 to 13 cm with a mean of 12.1 cm. The details of inter-parturition interval observed in this female which was living with her mate throughout the period of observation is given in Table 1.

From this table it can be seen that inter-parturition interval varies from 94 to 407 days mainly depending on the period of survival of the young. This female could give birth to six litters within a period of less than 3 years.

The incisors of the lower jaw of one young born here on 8-iii-1973 appeared in the second week and that of the upper jaw appeared in the fifth week. Whenever required, the mother used to lift the baby with the teeth mostly by holding the base of one of the hind limbs. At times just before moving with the baby, the mother used to handle the baby with her fore-limbs, probably to enable her to have a good grip of the baby with the teeth. The mother weighed 2.7 kg and the male 1.83 kg on 29-vii-1973. Other observations are more or less simliar to those observed earlier by Acharjyo & Misra (loc. cit.). The one female young born here on 8-iii-1973 with a weight of 74.5 gm at birth, attained her maximum weight of 2.770 kg at the age of 65 weeks (15 months). Weekly weight growth records were taken at the end of each week and an abstract of the same is given in Table 2.

Once the male was seen carrying the baby born here on 19-iv-1975 and gnawing the left hind limb within a few hours of birth. The mother followed the male attempting to save the baby. However, on our intervention the injured young was dropped by the male. Later the young died from the injuries.

Acharjyo & Misra (loc. cit.) stated that

TABLE 2

Dates	Age in weeks	Weight in Kg.
8-iii-1973	Birth	0.0745
5-iv-1973	4	0.227
3-v-1973	8	0.590
31-v-1973	12	1.010
28-vi-1973	16	1.375
26-vii-1973	20	1.795
23-viii-1973	24	2.032
20-ix-1973	28	2.135
18-x-1973	32	2.200
15-xi-1973	36	2.200
13-xii-1973	40	2.150
10-i-1974	44	2.230
7-ii-1974	48	2.310
7-iii-1974	52	2.370
4-iv-1974	56	2.535
9-v-1974	61	2.730
6-vi-1974	65 (15 months)	2.770
4-vii-1974	69	2.740
8-viii-1974	74	2.750
8-ix-1974	78 (18 months)	2.755

one female young weighed 77 gm, measured 29.5 cm including the 12.5 cm long tail and the eyes of this young opened on the 22nd day. They further stated that at the age of two months the young measured 59 cm in total length and weighed 445 grams. Nothing exact is known of the breeding habits of the giant squirrels (Prater, S. H., 1971: THE BOOK OF INDIAN ANIMALS).

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3. A RE-SURVEY OF THE STATUS OF WILD BUFFALOES IN WEST BASTAR, MADHYA PRADESH

INTRODUCTION

J. C. Daniel & R. B. Grubh (1966) conducted a brief survey of the Indian wild Buffalo, [*Bubalus bubalis* (Linn.)] to assess its status in Bastar District, Madhya Pradesh, and Orissa which are the last strongholds of wild buffalo in peninsular India. As a result of this survey the buffalo was declared an endangered species and was listed in the IUCN, Red Data Book. However, for the last ten years there has been no authentic study of the status of the buffalo population.

Therefore I undertook to resurvey the status of the wild buffalo in Bhairamgarh and Toinar Forest Ranges of the West Bastar Division covering most of the areas surveyed by Daniel & Grubh. The areas omitted were Pengonda, Farasnar, Dudapalli, and Kanglare of Toinar Range.

GENERAL ACCOUNT OF SURVEY

The survey was carried out from 18th March to 26th March 1975 covering Bhairamgarh and Toinar Forest ranges. The survey party consisted of myself, R. C. Chamaluram, Dy. Forester, Bhairamgarh range and two forest guides and tribal guides upto camp Kutru, thereafter Shri Parihar, A.C.E.F., West Bastar Division and Mr. R. C. Thind, Forest Ranger, Toinar range joined the party from Kutru onwards.

Four camps were made, three in Forest villages of Matwada, Jegur, Hingom and a fourth at Forest rest house at Kutru. Transects were made from three camps from early morning to late evenings, covering most of the area covered by Daniel & Grubh in west Bastar Division. Individual hoof marks were measured to identity the herd strength. Hoof marks which were not more than 24 hours old only were taken into account.

During 8 days of walks through the forest I saw only 3 buffaloes around 6 p.m. near Velcher area and these disappeared into patch of tall grass. The composition of herd could not be ascertained. I also saw 4 chital, 2 nilgai, 10 to 12 fourhorned antelopes (at night), 2 sambar (at night), porcupine (at night), 1 jackal, 2 sarus cranes. Apart from the above I thrice saw fresh pug marks of tiger. The remains of a python estimated to be around 20 feet long and a foot in width poached only

TRANSECT DATA

Four camps were selected namely Matwada, Jegur, Hingom, Kutru from which 8 transects on foot covering a total distance of around 110 Km.

TABLE 1

TRANSECT DATA OF THE WILD BUFFALO AREAS SURVEYED IN BHAIRAMGARH, AND TOINAR RANGE

Transects	Approx. distance in Kms. walked	Solitary tracts seen	Head tracts seen	Sighted	Total	Others
1. Matwada-Velcher Nala Matwada	12	—	3	—	3	Fresh tracks of Tiger, Bear.
2. Matwada-Kotmeta Hingom-Matwada	30	—	3	3	6	Sambar, Fourhorned antelope sighted.
3. Matwada-Bhalubhar—Jegur	15	—	—	—	—	Fourhorned antelope sighted.
4. Jegur—Barudi river—Indwada—Jegur	20	—	2, 3	—	5	Sarus cranes, and chital stags seen.
5. Jegur—Jegurnala Jegur	8	1	—	—	1	Fresh tiger track seen.
6. Kutru—Pathakutru river saltlick—Kutru	8	—	2	—	2	
7. Kutru-Ambeli Nala-Uskapatnam	12	—	2	—	2	
8. Pasewada—River Bank—pilor	20	1	3	—	4	
Total		2	18	3	23	

a few hours earlier was recovered during the survey and handed over to the forest ranger, Bhairamgarh.

I was told by the villagers of the Bandemark that they have often seen crocodiles in the Indravati river between Berabasti and Kotmeta during the last 2 to 3 months. I did not encounter any tracks of Gaur during the 8 days of the survey.

Human influence

The forest is being cleared continuously and converted into revenue land near Darbha and Jegur to settle tribals from Dantevara Tehsil. The new villages of Bandemark, Kotmeta, are settling down on the north and south banks of Indravati river encroaching on virgin forest land and destroying the forest cover needed for the wild buffaloes to reach the river. Tribals from numerous villages in the West Bastar division roam the jungles to graze cattle even into the interior forest driving the buffaloes to hill tops and hill slopes. Systematic communal hunts are still going on in these areas. The police and forest staff have hardly had any success in preventing these communal hunts during these years.

Kutru dam is to be constructed near Kutru dam site no. II. Trial drilling rigs and generating sets are working day and night, from the beginning of the year drilling for sample pile foundations. The noise of the drilling rigs could be heard from 3 km inside the jungle and during the night keeps the whole jungle awake. The large labour force employed by the companies have settled on both banks of the river.

[1] Daniel, J. C. & Grubh, R. B. (1966): The Indian Wild Buffalo, *Bubalus bubalis* (Linn.) in Penisular India. *J. Bombay nat. Hist. Soc.* 63(1): 32-53.

Comparative data

(Toinar & Bhairamgarh ranges only)

	Daniel & Grubh (1966)	Divekar (1975)
Solitary (Tracks seen & sighted)	15	2
Herd strength (Tracks seen & sighted)	71	21
Total	86	23

Probably not more than 50 buffaloes occur in the surveyed area of Toinar and Bhairamgarh ranges including those adjoining the Chandrapur dt. of Maharashtra, while Daniel & Grubh (1966)[1] had estimated 200-250 buffaloes in the same areas 10 years ago. No buffaloes were seen during the day on the entire length of river banks or in the adjoining forest patches. Herds larger than 4 to 5 individuals have not been seen the last couple of years by the tribals in these forest areas. The M.P. Government should develop without delay the long discussed Indravati Wild Life Sanctuary and offer complete protection to wild buffaloes under an able game management authority.

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4. AGGRESSIVE BEHAVIOUR OF DOMESTIC YAK

(*With two photographs*)

Patterns of aggressive behaviour have been described for various members of the subfamily *Bovinae,* notably for domestic cattle *Bos taurus* (Antonius 1933; Schloeth 1961), for gaur *Bos gaurus* (Schaller 1967), for American plains bison *Bison bison* (McHugh 1958; Lott 1974), and for African buffalo *Syncerus caffer* (Sinclair 1974). Little is known about wild yak *Bos grunniens,* except for some casual notes by explorers and hunters travelling through the species' range in Tibet and eastern Ladak (Hedin 1898; Rawling 1905; Schäfer 1937). The habitat of wild yak is now politically inaccessible, so my observations are limited to free-ranging domestic animals. During winter, villagers often permit their yak to forage at will in uninhabited valleys above an altitude of 4000 m. While conducting wildlife studies in Nepal and Pakistan, I made incidental observations on yak, especially at Lapche in northeastern Nepal and around the Karambar and Kilik passes in Pakistan. I also kept a young zoo-bred male yak at my home and he provided additional data.

The social structure of domestic yak herds did not correspond in every respect to that of wild ones. Domestic herds were small, often containing fewer than 25 individuals, and the sexes were sometimes kept apart. Wild yak may congregate in herds numbering 300 (Rawling 1905) and even 2000 animals (Schäfer 1937). Wellby (1898) wrote that "on one green hill we could see hundreds upon hundreds of yak grazing; there was I believe more yak visible than hill." Old males are usually alone or in bull herds of from two to five animals except in September and October when they join the cows during the rut (Hedin 1898; Schäfer 1937). In spite of the restraints imposed by domestication, semi-feral yak probably resemble their wild relatives in many aspects of behaviour.

Yak express aggression both indirectly and directly, using a combination of gestures, vocalisations, and postures. Interactions between grazing yak are infrequent, because, unlike domestic cattle, animals remain widely spaced, up to 20 to 50 m apart. However, they tend to congregate around midday and in the evening, often at wallows, and at such times aggression may occur.

Several vocalisations and other non-vocal sounds are used to express different levels of aggression. In low-level alarm situations such as when approached by a person, a yak often

blows lightly through its nose, a sound that may change to a snort. A cow with a small calf emitted several soft "bruu" sounds in similar circumstances. Yak also grind their teeth audibly during tense encounters. My yak first emitted this sound at the age of 13 months. The grunt is the yak's most characteristic call, as its scientific name "grunting ox" suggests. Grunts of fairly low intensity are used as contact calls, for instance when one animal suddenly sees another. But a harsh, explosive grunt, almost a bellow, given with open mouth, signifies high-level aggression. On the whole, yak are not vocal animals. The loud mooing and other sounds made when cattle or cattle-yak hybrids are herded toward the village are not evident among yak.

Harsh grunts are often associated with other types of behaviour. Both bulls and cows may hook at the sod with a sideways sweep of a horn, thrash a shrub, or rub their forehead on the ground either while standing or kneeling on their forelegs. A yak often rubs the side of its face and neck on the ground, especially when standing in a wallow. The bushy tail is raised vertically and may be lashed from side to side. This may lead to wallowing, a comfort behaviour which is commonly used during aggressive encounters. Lying on its side, the animal rolls over on its back, throwing up dust with its legs, an action that may be repeated several times (Photo 1). Wallows are usually located in dry areas, such as on ridges and along the edges of erosion gullies where through repeated horning the earth can be churned into a fine dust. Several wallows, roughly oval in shape and measuring 3 to 4 m in diamter, may be clustered around the same favoured site. On one ridge seven wallows were in line, spaced at 8 to 17 m intervals, with a cow resting in each one. Prater (1965) noted that yak "wallow in running water." I have not seen this, but my own yak began to lie in muddy depressions after horning them when 12 months old.

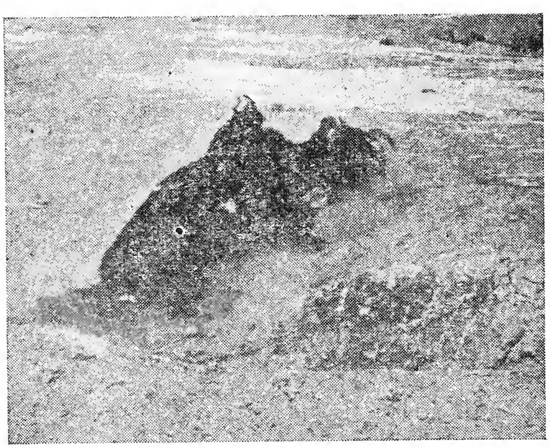

Photo 1. A yak bull rolls on a dust wallow (Hunza, November, 1974).

A dust-covered coat is thought to deter insects (Lott 1974), but wallows also serve social functions. Used repeatedly by both sexes, wallows become focal points at which animals express dominance, and where they leave olfactory signals, such as faeces and body odour. For example, on one occasion, two bulls and a cow had just left their respective wallows when a large, lone bull walked up a nearby streambed, his swaying head held low and his tail raised. He grunted hoarsely with his tongue hanging out. Twice he rubbed his face on the embankment before striding with grinding teeth to a just-vacated wallow. This he horned, rolled on it twice, and then walked 7 m to another wallow where he rubbed his face. Afterwards he stood there motionless, his head raised to shoulder level, as if advertising himself. On another occasion, a bull slowly followed an estrous cow, standing either beside her or behind her as she grazed. Once he licked her shoulder, another time her

head. But, suddenly he left for a nearby wallow which he horned before returning to her.

A striking behaviour is the lateral display in which the yak presents its impressive profile to an opponent (Photo 2). The bulky,

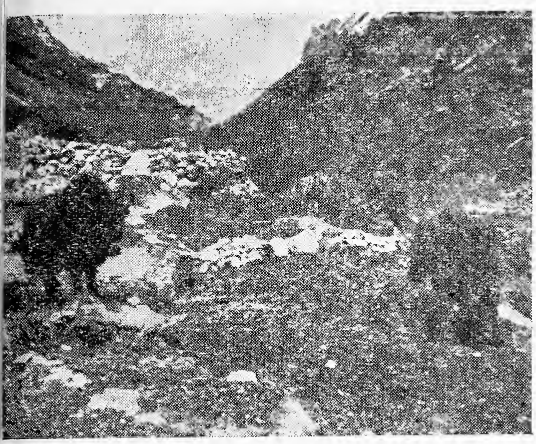

Photo 2. Two yak cows standing in a broadside display (Lapche, March, 1972).

black body with its conspicuous hump and the long, shaggy fringes of hair on neck, shoulders and sides are shown to best advantage during this display, especially by the huge bulls. Engelmann (1938) reported a 203 cm shoulder height, 80 cm horn length, and 821 kg weight in a wild yak bull, as compared to 156 cm, 51 cm, and 306 kg, respectively, in a wild cow, showing the marked sexual dimorphism in this species. During the lateral display opponents stand either head-to-tail or facing in the same direction some 3 to 6 m apart. The heads of one or both yak may be slightly averted as the animals stand motionless or circle showly, always presenting their broadside. Some displays may last at least 5 minutes, as one interaction at a wallow illustrates: one cow lies in a wallow when a second one walks up and faces her at a distance of 5 m. The newcomer grunts and grinds her teeth and lashes her tail for 10 minutes until the other cow rises. Both then stand broadside, 4 m apart, for 5 minutes before the first cow leaves the wallow and the other takes her place. The lateral display is one of the means by which yak of about equal size can assert or establish rank without physical contact.

Direct threats may consist of a lunge or charge, with head lowered and tucked in so that the horntips face the opponent, a butt, or a sideways and upward hook with the horn. Such behaviour is usually used by a presumed dominant individual to displace another, especially when herd members are crowded. Similar gestures are also shown toward potential predators such as dogs and wolves. Yak may then "all rush together and remain thus with their heads toward the threatened danger" (Rawling 1905). Muskox *Ovibos moschatus,* which superficially resemble yak and like them live in a harsh open environment, are also known to behave in this manner. Sparring, with two animals twisting and pushing against each other's forehead with locked horns, was recorded mainly among subadults and bouts were always brief and light. In fact, direct contacts were uncommon for most yak passively avoided encounters by turning aside, sometimes with head held low as if to graze or actually plucking a few blades. My yak tended to lick himself more often than usual when I asserted dominance, as perhaps another way of indicating lack of aggressive intent. When attacked, a yak may flee with its tail raised vertically and use a high-stepping trot reminiscent of a caribou's *Rangifer tarandus* gait. Sinclair (1974) noted that subordinate African buffalo often turned from an opponent with head raised, a posture similar to the typical alarm stance in *Bovinae.*

Although further observations will no doubt broaden this agonistic behaviour repertoire,

some preliminary comparisons with other *Bovinae* are relevant. The basic fighting methods are similar in all species, as are most submissive gestures, whereas the indirect threat postures vary (Table 1). Of the five species listed, all bulls except the African buffalo bellow during aggressive encounters. All species use the lateral display to intimidate opponents. Tooth grinding has been described only in yak. I have not seen head-tossing in yak, though it may well occur as it does in the other species. African buffalo jerk their heads up during lateral displays (Sinclair 1974), but bison stand face to face and bob their heads (Lott 1974). Several patterns are associated with wallowing and Schloeth (1961) suggested that pawing, horning, and rubbing the face on ground were derived from wallowing behaviour. Domestic cattle do not wallow, but they retain the morning and other patterns (Schloeth 1961). Gaur wallow seldom and rarely use such related gestures as rubbing the face on the ground (Schaller 1967), suggesting that these patterns are mainly associated with body care rather than with aggression. On the other hand, dust bathing is a conspicuous activity of yak, and in this respect the species resembles *Bison* rather than *Bos*. With regard to buffalo, Sinclair (1974) noted that "subadult males and females have never been seen to cover themselves with mud", the behaviour being limited to adult bulls. Yak cows commonly wallow, although bulls probably do so more frequently, as do bison bulls (McHugh 1958). Pawing is common in bison whereas it is rare in yak and African buffalo. So far only bison have been reported to urinate in their wallows (Lott 1974).

TABLE 1

THE OCCURRENCE OF SOME INDIRECT AGGRESSIVE PATTERNS IN SEVERAL *Bovinae*

	Bos taurus (Schloeth 1961)	*Bos gaurus* (Schaller 1967)	*Bos grunniens* (this study)	*Bison bison* (Lott 1974)	*Syncerus caffer* (Sinclair 1974)
Loud grunting or bellowing	+	+	+	+	
Tooth grinding			+		
Horning earth	+		+	+	+
Horning vegetation	+	+	+	+	+
Rubbing face and neck on ground	+		+	+	+
Pawing earth	+	(+)		+	(+)
Wallowing		(+)	+	+	+
Urinating in wallow				+	
Lateral display	+	+	+	+	+
Head tossing	+	(+)		+	+

+ = trait present; (+) = trait present but rarely shown; a blank space indicates trait either absent or not recorded.

Behavioural similarities can often be related to environmental conditions or phylogenetic relationships. *Bos* and *Bison* are known to be more closely related than *Bos* and *Syncerus*. It is tempting to ascribe the resemblances in behaviour between yak and bison to the simi-

larity in their social structure and habitat. Cattle, gaur, banteng, and other *Bos* are essentially woodland animals living in relatively small groups, whereas yak and plains bison are open terrain animals where they may concentrate in huge herds. However, the European bison *Bison bonasus* is a forest dweller, and, judging by descriptions quoted in Lott (1974) and Sinclair (1974), its behaviour is similar to that of its New World counterpart. As Heptner *et al.* (1966) have noted, yak show some morphological traits which represent connecting links between cattle and bison. For this reason yak are sometimes placed into the separate genus *Poëphagus*. The observations suggest that yak may also occupy an intermediate position between *Bos* and *Bison* in some aspects of their behaviour.

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NEW YORK ZOOLOGICAL SOCIETY,
BRONX PARK, NEW YORK,
August 5, 1975.

GEORGE B. SCHALLER

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5. SOME NOTES ON THE WHITE STORK *CICONIA CICONIA*, THE BLACK DRONGO *DICRURUS ADSIMILIS* AND THE STARLING *STURNUS VULGARIS*

On the 19th January while motoring to Ahmedabad, I saw a sight which is worth recording. Some 25 km from the city between Bavla and Sarkhej there is a broad expanse of irrigated land benefitting from the sewage of the city. Here, I noticed a large congregation of storks and since this part of the road always has a few White Storks, and a little further back

having seen an isolated bird, I had the car stopped and scanning the assemblage, I was surprised to count eighty of this species. They were all resting along an earthen embankment beyond which there was a small jheel in which Large and Lesser Egrets were wading while a flock of Painted Storks stood hunched up and obviously replete a little to one side. A flock of about ten Demoiselle Crane were also resting a little further away. It was interesting to note that the storks were not in the least shy and took no notice of the men working nearby. This should not draw comment considering the fact that in its breeding areas, it is very tame and builds its bulky nests on chimneys and minarets, but I find it noted in the HANDBOOK that ".... the bird is usually wary and difficult to approach in its Indian winter quarters."

There are several pairs of White Storks in the Ahmedabad Zoo and these have been rearing young there now for several seasons. I had the opportunity of seeing them producing the bill clattering sound. While the head and bill are brought down, the tail is often spread and slightly raised like a turkey and the wings droop to the sides.

All over Saurashtra the popular snack item is the "ganthia" fried gram paste. This is available either in flattened pieces, or as thin sticks a few centimetres long. Near my house in Rajkot, a small ganthia shop is now a favourite assembling spot for about fifty Black Drongos prior to going to roost. They line the electricity wires and snap up pieces thrown to them by customers. A handful of pieces thrown up will be dextrously caught by as many fluttering birds. The sight is thrilling to watch. This is a distinctly new taste in food for the drongo since as the HANDBOOK says "Predominantly insects; on occasion lizards, small birds... and small bats.... Very partial to flower-nectar.... Moths and butterflies (occasional);.... Among stomach contents of specimens from an intensively cultivated tract in Bihar the following insects (mainly agricultural pests) classified...... Has been observed to capture the ferocious rock bee *Apis dorsata.*" There have been no previous records of drongos coming to feed on scraps thrown out by the housewife, nor have these birds, common and confiding though they be, have ever visited breakfast tables for titbits as many others commonly do.

For several days three Starling have been visiting our area and probing for food along the gutters. Starling are not common though a few individuals are regularly seen in winter on wet pastures near jheels and rivers as well as in irrigated crops. This is the first time that I have seen them in an urban setting.

LAVKUMAR J. KHACHER

RAJKOT,
January 30, 1975.

6. OCCURRENCE OF THE BLACK STORK (*CICONIA NIGRA*) IN SAURASHTRA

On 30-i-1975 I took Mr. Koning who is studying the Wildfowl wintering populations of South West Asia to the lake near Jasdan and we saw 3 Black Storks. There are a couple of very old records of its occurrence in Kutch and Deesa and Mr. Harinarayan Acharya has seen them near Ahmedabad but so far it has not been recorded in the Saurashtra peninsula.

Incidentally Mr. Koning recorded several Mallard, which are very uncommon on this side as well as 2 Common Shelduck (*Tadorna tadorna*) on this visit on the lakes near Rajkot and Jasdan and the Bhadar Dam near Gondal.

SHIVRAJKUMAR KHACHER

THE PALACE,
JASDAN,
February 7, 1975.

7. COMMON TEAL *ANAS CRECCA* MIGRATING ACROSS THE HIMALAYAS

On 14th May 1975, while going up the Solang Valley from Manali, Himachal Pradesh, we were met by a group of trainees from the Western Himalayan Mountaineering Institute, Manali, on their way down from high altitude training at the head of the valley. They showed me a live duck of the above species which had been picked up exhausted at about 11,000′ below the snowfields. The bird showed its flight feathers badly abraded but apart from this had no external signs of injuries. For a week before the weather had been bad with a wind blowing down the valley. Quite apparently, the bird was unable to cross the snow range which stands to the north at the head of the valley. This further shows that ducks do fly across the high ranges at considerable altitude and this particular bird must have been one of a flock on its way to Central Asia across the western parts of Tibet.

LAVKUMAR KHACHER

C/o. WWF-INDIA,
HORNBILL HOUSE,
S. BHAGAT SINGH ROAD,
BOMBAY 400 023,
June 21, 1975.

8. DEMOISELLE CRANES NEAR POONA

A flock of about 1000 Demoiselle Cranes was first sighted on 15th January 1975, on the banks of Veer Dam reservoir about 45 miles south-east of Poona City. There were reports in the press that flocks of large, stork-like birds were damaging the crops in that area. But when we reached the spot early morning we could not spot a single bird. However, black specks suddenly appeared in a clear, blue sky late in the morning, becoming ever larger as they began descending. Presently the whole flock slowly circled downwards, lowered their legs and gently touched ground. More and more flocks soon appeared from all directions and touched ground one by one. Within half an hour more than a thousand birds had assembled on the southern bank and some scattered flocks could be seen on the distant northern bank. Each flock consisted of from 30 to 50 birds.

As we watched the birds from a distance of about 150 metres, some birds were seen just standing in toe-deep water, some trying to pick something up from the sand, some

sauntering around a few paces and some bugling from time to time.

All of a sudden a scattered flock would rise in the air, but did not go very high and soon settled down after describing a circle in the sky. Towards evening however, some flocks disappeared over the horizon to forage.

We enquired in the nearby villages and were told that the flocks assembled every year within a month after the Diwali Festival and spent about 3 months at that site. They foraged in fields in the plains as well as in hills, doing great damage to the crops of gram and 'kardi' (hence the name *Karadi-Karkocha* in Marathi), uprooting sometimes the whole plant in their attempt to pluck the tender shoots. The flock habitually spent the whole night and a major part of the day on the sandy banks of the reservoir.

For our next visit to the spot we reached there during the night and began our vigil very early in the morning before day-break. However, no call or movement was perceived till dawn when bird after bird began to shake off slumber. From 6.45 onwards small groups began to rise in the air and by 7.30 a.m. most of them were air-borne. The birds flew in a peculiar formation. First birds scattered over a wide area took to wing and gained some height when a rather compact group was formed. The group slowly elongated to form a long file with a leader at the head and a broad tail. While a few flew east and west, a majority of the birds headed towards hills to the south to feed.

After 10.30 a.m. however, flocks that had gone in different directions began to return to spend the rest of the day at their favourite spot on the south bank of the reservoir.

PRAKASH GOLE

184, SHANIWAR PETH,
POONA 411 030,
July 18, 1975.

9. A NOTE ON INCUBATION PERIOD AND REPRODUCTIVE SUCCESS OF THE REDWATTLED LAPWING, *VANELLUS INDICUS* AT DELHI ZOOLOGICAL PARK

The Redwattled Lapwing is a familiar bird in India frequenting open cultivation, ponds and rivers (Whistler 1941). In spite of its wide distribution and familiarity, information about its reproductive biology is lacking in literature. Jayakar & Spurway (1968) recorded 28.5 days as incubation period in Yellow-wattled Lapwing (*Vanellus malabaricus*). Ali & Ripley (1969) mention that the incubation period in Redwattled Lapwing is not recorded. The incubation period in Charadriidae is 25 days (Lack 1972).

The present study was carried out during 1973 and 1974 at the Delhi Zoological Park which extends over an area of 240 acres. The park which is developed as a woodland has large open-air animal enclosures bounded on one side by water moats. There are also ponds and channels in the park for the display of free-flying water birds. The Redwattled lapwing is a free-flying resident species and was observed to nest regularly on the plain ground in the open animal enclosures, lawns and other areas of the park. For the purpose of this

study more than 20 nests were observed during 1973 and 1974. The measurements and weights of eggs and chicks were taken with vernier callipers and analytical balance. The period of incubation was calculated as the interval between the day of laying to the day of hatching (inclusive of both days) for each individual egg. Observations of the nests were made during early morning, forenoon, and late afternoon on successive days. Ten nests during each year were taken into consideration for estimation of reproductive success.

Thirty eight eggs were weighed and measured during 1973 and 1974. The eggs weighed between 16.5 gm to 21 gm with an average of 19.25 gm. The average size of the eggs was 41.7 x 33.5 mm with a range of 43.5 to 39.6 mm x 31.8 to 29.5 mm.

The incubation in the Redwattled Lapwing started with the laying of the first egg. Both the sexes shared in the incubation of the eggs. Ten eggs were marked with indelible India ink for the determination of the incubation period at the Delhi Zoological Park.

The incubation period ranged from 28 days to 30 days with an average of 29.2 days. Out of the ten eggs studied, 2 eggs hatched in 28 days, 4 hatched in 29 days and the remaining 4 hatched in 30 days (Table 1).

The young of the Redwattled Lapwing are nidifugous. At hatching, the chicks are covered with brown down feathers. Eight chicks were weighed and measured soon after they were hatched. The chicks weighed 14.80 gm to 13.20 gm, the average weight was 14.02 gm. The bill average 11 mm in length and the middle toe ranged from 16 mm to 19 mm with an average of 17.1 mm.

During the present study ten nests were taken into consideration each year for determining the reproductive success of the Redwattled Lapwing. The data for the ten nests are summarised in Table 2. The overall reproductive success was 40% during 1973 and 41.02% during 1974. Jayakar & Spurway (1965) stated that the reproductive success of Yellowwattled Lapwing ranged from 54% to 64%.

TABLE 1

INCUBATION PERIOD OF THE EGGS RECORDED AT DELHI ZOOLOGICAL PARK

Nest No.	Date of laying	Date of hatching	Incubation
5	18.4.74	16.5.74	29
	20.4.74	17.5.74	28
8	18.4.74	17.5.74	30
	20.4.74	18.5.74	29
	22.4.74	19.5.74	28
9	16.4.74	15.5.74	30
	18.4.74	17.5.74	30
	22.4.74	20.5.74	29
2	2.4.74	1.5.74	30
	4.4.74	2.5.74	29
	6.4.74	missing	—

TABLE 2

REPRODUCTIVE SUCCESS OF REDWATTLED LAPWING AT THE DELHI ZOOLOGICAL PARK DURING 1973 AND 1974

Reproductive data for 10 nests	1973	1974
1. Total number of eggs laid	35	39
2. Total number of eggs hatched	17	22
3. Percentage of eggs hatched	48.57%	56.41%
4. Total number of hatched young that fledged	14	16
5. Percentage of hatched young that fledged	82.35	72.7
6. Overall nesting success	40%	41.02%

The heavy predation on the eggs at the Delhi Zoological Park accounted for the low reproductive success of the Redwattled Lap-

wing. During 1973, 51.4% eggs (18 eggs out of 35 eggs) were either destroyed or taken away by mongooses, crows and kites, while in 1974, 43.5% eggs (17 eggs out of 39 eggs) were lost to predators.

In comparison, mortality among the chicks was 8.3% in 1973 and 15.4% during 1974. It has been observed that once the chicks reached the age of two weeks, their chances of survival were much better.

Delhi Zoological Park,
New Delhi-110003,
July 25, 1975.

J. H. DESAI
A. K. MALHOTRA

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10. EXTENSION OF RANGE OF THE LARGE YELLOWNAPED WOODPECKER (*PICUS FLAVINUCHA FLAVINUCHA* GOULD)

Recently we had an opportunity to assist Sálim Ali and S. D. Ripley, on a survey of the avifauna of certain forested areas in Orissa to explore the possibilities of rediscovering the Blewitt's Owl [*Athene blewitti* (Hume)]. At the conclusion of the trip it was possible for three of us, with generous financial support from Dr. Ripley, to continue the survey in Andhra Pradesh to look for the Jerdon's Courser [*Cursorious bitorquatus* (Blyth)].

During the course of this trip we obtained a specimen of the Large Yellownaped Woodpecker near Sileru *c* 900 m on the Eastern Ghats in the Vishakapatnam district, A.P., on 18th March 1975. This bird affects open mixed evergreen and deciduous forest between 2400 m in the Himalayas down to the plains. Both the IND. HANDBOOK and the SYNOPSIS give its southernmost range as Orissa (Simlipal Hills). The present specimen was obtained about 650 km south of the accepted range.

Some of the higher hills in this area contain thick vegetation, grassy slopes and sholas resembling the evergreen biotope of the Nilgiris in South India. A detailed survey of these hills may produce some very interesting results. The specimen, a female, is now with the National Museum of Natural History, Washington.

Bombay Natural History Society,
Hornbill House,
Shahid Bhagat Singh Road,
Bombay-400 023,
August 19, 1975.

S. A. HUSSAIN
J. D. PANDAY
P. B. SHEKAR

11. NEW NAME FOR ANDAMAN BLACKHEADED ORIOLE, *ORIOLUS XANTHORNUS ANDAMANENSIS* ABDULALI

In 1968 (*JBNHS 63*:421-22) I described and named *Oriolus xanthornus andamanensis* from the Andaman Islands, overlooking the prior use of the name in the same genus in *Oriolus andamanensis* Tytler (*in* Beavan, 1867, *Ibis*, p. 326) now a subspecies of *O. chinensis* L. This makes *Oriolus xanthornus andamanensis* a primary homonym of *O. andamanensis* Tytler and must be rejected and replaced. I therefore rename the subspecies as:

Oriolus xanthornus reubeni nom. nov.

after Mr. David E. Reuben, I.C.S. (Retd.) who served on the Executive Committee of the Bombay Natural History Society from 1954 to 1975 and who over many years has advised and assisted me with the drafting and editing of ornithological and other notes and papers.

I am grateful to Mr. Murray Bruce of Turramurra, N.S.W., Australia, for drawing my attention to the error.

HUMAYUN ABDULALI

FAIZ & CO.,
75, ABDUL REHMAN STREET,
BOMBAY-400 003,
December 22, 1975.

12. REDVENTED BULBUL, *PYCNONOTUS CAFER* NESTING IN A HOLE IN A MUD BANK

On 29th May, 1975 I came across a Redvented Bulbul's nest placed in a hole in the mud bank of Chor Khala, a rain water nulla at Dehra Dun. The hole was situated at the hight of 1.3 metres from the ground; it was 15 cm in diameter and 22 cm deep. The entrance was effectively concealed by a bush growing in the mud bank about 25 metres below the hole. The nest contained 4 eggs, two of which ultimately hatched out.

In the existing Indian ornithological literature including the comprehensive collations of Hume and Oates (1889-1890), Baker (1932-1935) and Ali & Ripley (1968-1974) this species has not been recorded as placing its nests in holes.

B. S. LAMBA

ZOOLOGICAL SURVEY OF INDIA,
13, SUBHAS ROAD,
DEHRA DUN,
July 18, 1975.

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13. ON SOME NESTS OF THE TAILOR BIRD (*ORTHOTOMUS SUTORIUS*)

(*With six text-figures*)

In July-August, 1973, a pair of Tailor Birds built a nest in our backyard in Trivandrum, Kerala, raising three young. The behaviour of the adults and their brood has been dealt with in another note (*JBNHS*. Vol. *73*, pp. 219-222). Dr. Sálim Ali was good enough to suggest that my comments on that nest should be written up to form a separate note. Between August 1973 and June 1975 I was able to examine 4 more nests of the Tailor Bird from 3 of which the young had flown, while the fourth was deserted soon after completion. Details regarding these nests are:

	Nest 1	Nest 2	Nest 3	Nest 4	Nest 5
Date on which nest was taken	1.8.'73	26.2.'74	26.6.'74	18.7.'74	5.5.'75
Name of plant in which built	*Michelia*	?	Coffee	Money-plant	*Dioscorea alata*
Approx. height from ground	60 cm	50 cm	224 cm	224 cm	184 cm
No. of leaves used	3	3	3	1	1

NEST 1: Three large leaves were joined together to form a long, tapering cup, with one of the leaves bent over to form an efficient roof (Fig. 3B). The weight of the nest was borne chiefly by leaf A (Fig. 2). Leaf B was so fixed that it could bend outwards to provide more room inside as the nestlings grew. Originally, leaf C had also been bent upwards and attached to leaves A and B, but most of the links had broken free within a fortnight and the leaf had again become straight. The surviving links. mostly of cobweb, were so strong and elastic that considerable force had to be exerted to free leaf C.

This nest was composed of very fine, coarse fibre, thin roots, cotton, a small quantity of plant-down (such as the pappus of *Calotropis* etc.) and a few tiny feathers. (In one of the nests, the quantity of plant-down was much greater than that of cotton). The cotton appeared to serve as a 'filler' or stuffing between two layers of fibre, and also as a source of the untwisted threads used to join the actual

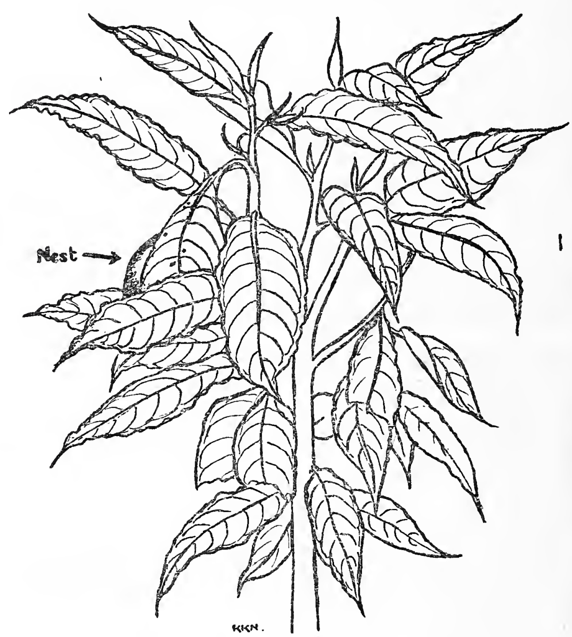

Fig. 1. Nest 1 (all leaves not shown).

nest to the supporting leaves. Except in nest 4, there was no soft lining or cushion of cotton or plant-down to serve as a bed for eggs and young. Nor was there a distinct inner-cup of finer roots, grass stems or other soft material. Nest 4 differed from the others in that it had an inner lining of cotton which was very thick on the side farthest from the entrance (Fig. 5). Buried in this was an infertile egg (which contained only a thin, yellowish, odourless fluid). Two pulli had been reared successfully in this nest, and the cotton cushion had been thoroughly pressed down. Most probably the cotton had been used to cover up the infertile egg and to prevent it from breaking and fouling the nest.

When nest 1 was collected a day after the young had flown, a soft whitish powder, very similar to dandruff, dribbled from the base. This flaky material had accumulated between the leaves and the nest, mostly at the bottom. This was found in all the nests except No. 5 (in which no eggs were laid). While the floor and sides of the egg-chamber in nests 1, 2 and 3 showed no traces of this powder, the cotton lining in nest 5 contained a fair quantity of it.

The contents of the leaf-cone of nest 1 were carefully sorted out and weighed in a sensitive balance (by Dr. A. J. Michael, Professor of Physics, whom I take this opportunity to thank).

The fibrous material weighed		850 mg
Cotton and plant-down	"	1.48 mg
7 tiny feathers together	"	29 mg
The flaky powder	"	218 mg

Figures 3A, 3B and 4 show details of nest-structure. The roots and fibre of the egg-chamber had not been coiled round but appeared to have been simply pressed down. The thickest part of the nest held a thick pad of cotton intermixed with fibre. Two tiny feathers were embedded in the material of the rim, one at the entrance and the other at the

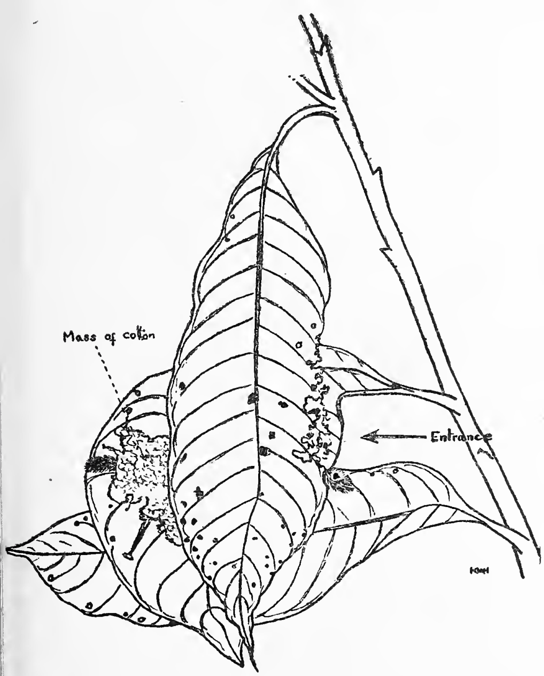

Fig. 2. As seen from the southeast.

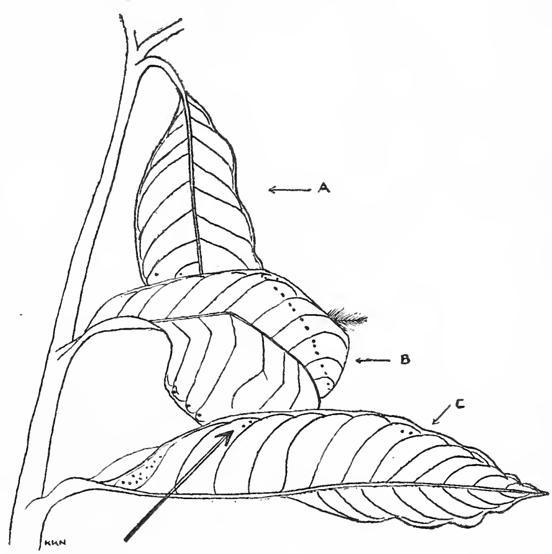

Fig. 3A. Nest as seen from the north.

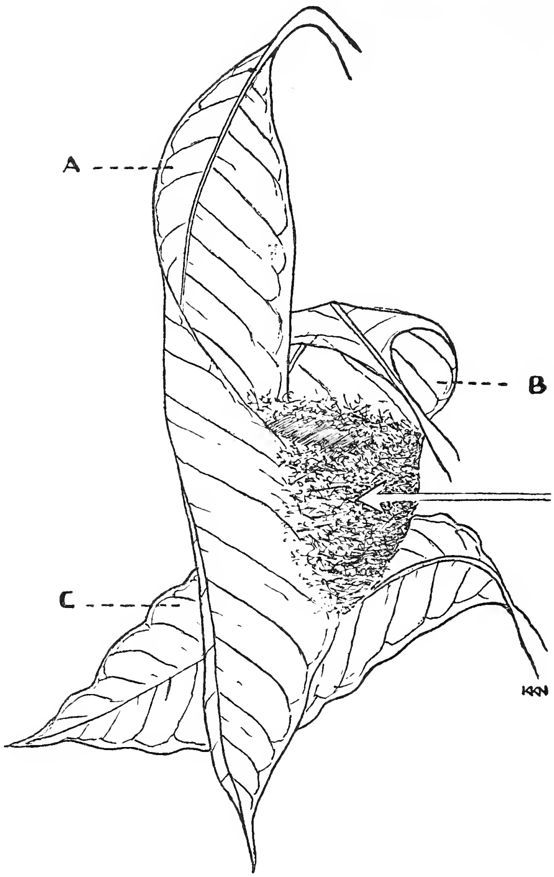

Fig. 3B.

opposite point (Fig. 2). Five more small feathers were incorporated in the nest. The 'foundation' or outer lining next to the leaves contained pieces of fairly straight, dark brown fibre. Fine roots and fibre were mixed up with the cotton and plant-down except where a mass of cotton projected at the back.

No cotton *yarn* was used to join the leaf-edges. Wherever the links were of cotton, the material had been pulled through a hole and fluffed out or flattened, or shaped into a ball. There was nothing resembling a knot in the limited sense of 'a lump or knob in a thread, formed by passing one free end through a loop and drawing it tight, or by a tangle drawn tight' (Webster's NEW WORLD DICTIONARY). But for a few strands of strong, elastic cobweb which ran through more than 2 holes, there were no running stitches in nest 1. In some of the others there were many more. These were noted chiefly at points where the leaf-edges came closest, as at the top and the bottom. As a rough generalisation it may be said that cobweb, fine roots and fibre were

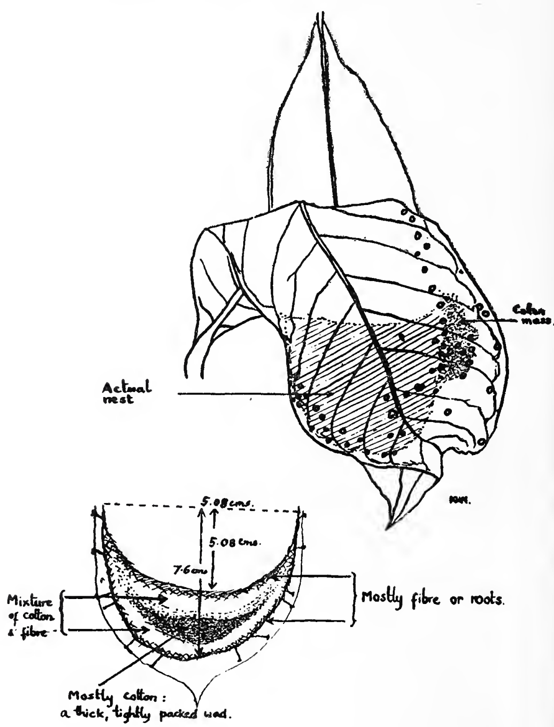

Fig. 4.

used in joining the leaves together, while cotton was employed to fix the nest proper to the leaf-cone.

So far as the number of perforations made and 'stitches' put in are concerned, nest 4 was

the one which showed the greatest economy. It was also the most elegant-looking of the lot.

Nests 1, 2 and 3 were supported by three leaves each. Of these, only in No. 2 had one of the leaves (the one originally bearing most of the weight) withered and broken free from the twig. On one or two of the leaves of nest 1 brown patches developed gradually here and there. In every instance it was found that withering had started at a point where the midrib or a vein of the leaf had been injured by the bird's bill.

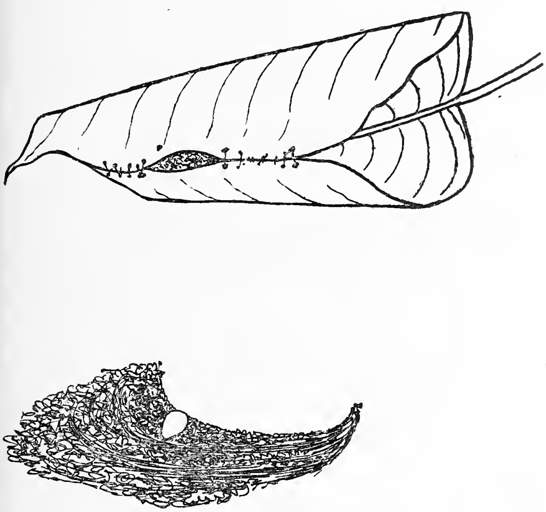

Fig. 5. Nest 4.

The following is a purely hypothetical reconstruction of the way nest 1 was built. After selecting the site and the leaves, the birds seem to have sewn together the edges of leaves A and B using cobweb, rootless and fibre. A thin inner lining of roots and fibre came next. More of this material was placed at the bottom of the cup, and cotton and plant-down laid on this. After this, or during the stuffing, little masses of cotton were drawn through the fibre lining and the leaves at various points. Leaf C was most probably joined to the base and sides at this stage. Where the strain was likely to be greatest, a neat row of such insertions of cotton had been made (Figs. 3A and 4). The cobweb used to join the leaf-edges together had amazing tensile strength. Of the various strands which had originally linked leaves A and B with C, the only 2 that survived till 14.viii were enough to hold up leaf C, and attempts to sever the connection by inserting two fingers and gently pushing the leaves apart failed. When the pressure was increased, the leaf was torn and yet the threads did not break.

On one side leaves A and B overlapped, and

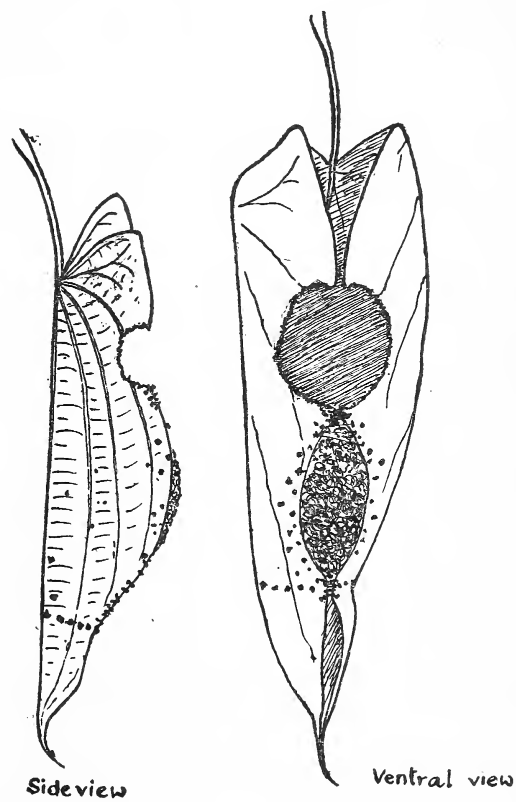

Fig. 6. Nest 5.

had been so thoroughly stabbed with the bill to make cotton 'rivets' that on 14.viii the two leaves could hardly be distinguished at this place (arrow, Fig. 3B). By 23-viii the edge of leaf A on the left side of the entrance had become frayed and lace-like, apparently due to the movements of the female. In nest 5, most probably because the edges of the soft, thin leaf tended to curl up or come together, the bird had snipped off a piece from either edge leaving a neat circular opening (Fig. 6).

The shape of the leaf-cone has an influence on the shape of the true nest. When two or more leaves are used and the nest hangs down vertically, the distance between the bottom of the cup and its edges is constant; but when only a single leaf is used and the cone hangs at an angle of 45 to the horizontal, the rim is higher at the back of the nest. In nests of the first type, the thickest part is below the nest-cup; in the others it is on one side, at the back (Figs. 2 and 5).

Nest 1 was completed on 15-vii-1973. After that, only on one occasion (at 1122 hrs. on 21.vii), when the female brought a few strands of fibre or rootlets, was any material added to the nest.

UNIVERSITY COLLEGE,
TRIVANDRUM, KERALA,
July 15, 1975.

K. K. NEELAKANTAN

14. OCCURRENCE OF THE BROADTAILED GRASS WARBLER [*SCHOENICOLA PLATYURA* (JERDON)] ON THE COROMANDEL COAST

The Broadtailed Grass Warbler, "Funny little birds..." as Hume quotes Frank Bourdillon's letter (A. O. Hume, STRAY FEATHERS 9:211), has a patchy distribution in the south-western part of the Indian peninsula ranging from Belgaum in the north to Kodaikanal and Madurai in the south. The occurrence of this species in Sri Lanka is recorded on the basis of a single specimen housed in the British Museum, and two later unconfirmed sight records by W. W. A. Phillips in 1939.

In the course of a survey of birds of Pudukottai district, Tamil Nadu, we had an opportunity to visit the nearby Point Calimere sanctuary in Thanjavur district, on 28th November '75. Late in the evening, a forest guard brought in a live bird which had blundered into the forest rest house near the seashore. It was at once identified by Dr. Sálim Ali as the Broadtailed Grass Warbler. In view of the unusual occurrence the bird was kept for confirmation at the Society. It is not known whether this species is given to annual migration, but considering the records in Sri Lanka (though the specimen in the British Museum bears no date) and it being normally a resident of the wetter southern portion of the Western Ghats, its occurrence on the seashore of Point Calimere suggests that it may have been on passage to Sri Lanka which is only about 25 miles across Palk Strait. It is interesting to note that several birds of the typical evergreen forests of the Western Ghats like the Threetoed Forest Kingfisher (*Ceyx erithacus*) and the Pied Ground Thrush (*Zoothera wardi*), a Himalayan migrant, were ringed

during the course of Society's bird banding camp at Point Calimere [K. S. R. Krishna Raju & P. B. Shekar *JBNHS 68* (2):437]. These records as well as the regular migratory pattern of certain other species studied here, strengthen the assumption that Point Calimere, a dry thorn scrub habitat on the east coast, is a major migratory route to Sri Lanka.

S. A. HUSSAIN

BOMBAY NATURAL HISTORY SOCIETY,
HORNBILL HOUSE,
SHAHID BHAGAT SINGH ROAD,
BOMBAY-400 023,
January 20, 1976.

15. THE LIZARD *SITANA PONTICERIANA* IN CAPTIVITY

Capture: On the morning of 1-vi-74, which was sunny with a light breeze, SDO and I were walking on the hill beyond Vetal Temple, west of Poona's western suburb of Erandavane. On a small stony outcrop, some fifty yards distant, we saw what appeared to be two brilliant blue butterflies, about the size of a small *Precis*, fluttering some four feet away from each other. Putting up my binoculars, I found that these "butterflies" were the fully expanded gular appendages of two lizards that sat facing each other. With the idea of capturing one or both, I approached cautiously. When I was only a few feet away, one lizard dashed off into the open ground, and thinking it would be easy to capture it, I ran in pursuit. The lizard showed a surprising turn of speed, and as I reached it, dived into a deep crack in the soil, where I was unable even to catch a glimpse of it. On my return to the stony outcrop, I found that the other lizard had vanished.

Proceeding about half a mile from that spot, we met a group of boys, to whom we described the "lost" lizards. Presently one of the boys said, "Look, there's one—do you want it?" He pointed to a lizard, rather smaller than the first two, but obviously of the same species, sitting on a mound not far away. This the boys captured for us, drawing a little of its blood in the process, though without inflicting any material injury. I wrapped the lizard loosely in my handkerchief and carried it home. The wound, which I could not locate, evidently healed within a short time.

Accommodation: The lizard was kept in a cage made from a packing-case 9½ inches high, 11½ inches wide, and 7 inches deep; of the front side, the lower two-thirds portion was a glass sheet, the upper one-third being wire mesh. A small bowl of water was placed in one corner. A curved piece of flower-pot was supplied for a hiding-place, but this was never used as such during the whole period of captivity. Acting on a suggestion, I covered the floor of the cage with about two inches of loose soil, expecting that the lizard might dig into this; however, he never did so. After the correct food was experimentally discovered, I kept two glass tumblers, containing grasses sprouting in wet soil, at one side of the cage.

Description: The overall length was 7½ inches, five of these being accounted for by the finely tapered, and normally upturned, tail. The base of the tail was of the thickness of the thighs. All four limbs were slender and re-

markably graceful. The gular appendage was of a rich irridescent blue, paler and less noticeable when folded against the throat than when fully inflated into a forward-thrusting fan. The breast immediately below the appendage was of a warm orange (exactly the colour of *Butea frondosa* flowers) surrounded by a narrow border of deep black. All the rest of the colouring formed an intricate and artistic pattern of grey, yellow-gray, cream, and both light and dark chocolate-brown, with slight washes of pale green and yellow. A very narrow pale-blue line ran down the diamond-shaped markings of the vertebral area.

In all, this was a singularly beautiful and attractive creature. The brightness of the gular blue and the pectoral orange faded somewhat during the ensuing months, but never disappeared. The reptile's size showed no increase.

Food and Feeding: The acceptable food was found, by experiment, to be grasshoppers of all sorts; adult termites were also taken when available. Worms, beetles, ants and flies were ignored. The lizard sometimes, though not often, stalked his prey; he usually waited for it to approach within reach. The grasshopper was usually left alone until it moved, when it would be swiftly seized in the jaws. Swallowing was done by convulsive throat and head movements, during which the gular fan would be half opened. Sometimes an insect would be bitten in two, one portion falling on the earth; the fallen portion would sometimes be retrieved later, sometimes abandoned. I could usually induce the lizard to seize even a dead insect if I artificially agitated it within reach. Once or twice the lizard pursued an insect which had climbed up the wall of the cage. I did not observe a preference for any particular colour of grasshopper.

Not more than once or twice did I observe the reptile drinking. During this act the forelegs were rested on the rim of the bowl and the head was thrust into the water for a few seconds.

Sleeping: This took place only at night. The postures varied, apparently at random. Sometimes the lizard slept in a horizontally prone position, with his underside resting flat on the earth. At least as often, he slept reared up against the wall of the cage, very securely supported on the tripod of his thighs and tail-base. Once or twice he hung all night on the wire-mesh portion of the cage's front, head upwards.

Other habits: At first the lizard showed a bounding energy, often jumping almost from end to end of his cage, darting up the walls (which he could climb almost to the top) and taking flying leaps up to the wire mesh or on to the grass growing in the glass tumblers.

This energy showed a gradual and progressive decrease, which I now attribute to a deficiency of sunlight. Since my flat faces west, the cage could be placed in sunshine only for the later afternoon. I believe the lizard's death, which took place on 27-xi-75, might have been avoided if I had made arrangements to keep the cage in sunlight for longer hours during the coldish winter days. If the reptile had felt the effects of mere cold, as opposed to lack of sufficient sunlight, I should have expected him to burrow into the soil, or at least to take shelter beneath the piece of flower-pot; yet he did neither of these things.

THOMAS GAY

DEV KUNJ,
PRABHAT ROAD,
POONA,
September 25, 1975.

16. COLLECTION AND HATCHING OF MARSH CROCODILE (*C. PALUSTRIS*) EGGS

The Madras Snake Park collected mugger eggs in Tamil Nadu for the second season this year. During April and May seven nesting sites were visited, and four wild nests were transported to the hatching area in the Park. The areas visited were: (1) Vakkaramari Waterworks, Chidambaram; (2) Elathur, Coleroon River; (3) Kilikuddi Tank, Grand Anicut; (4) Amaravathi Dam, Chinnar and Munnar Rivers; (5) Bhavanisagar, Bhavani and Moyar Rivers; (6) Hogenakal Falls, Stanley Reservoir, Cauvery River; and (7) Sathanur Dam, Ponnaiyar River.

1) **Vakkaramari Waterworks:-** 19-iv-75

Area: Forty acre waterworks with two large tanks, feed canal and pumping station. A 30 feet bund divides the tanks. Sparse vegetation.

Number of mugger: 15 adults and sub-adults:

Nests found: Nest 1 was on the centre bund, 1½ metres from the waters' edge. The eggs had been laid the night before (fresh mucous on top egg, scattered fresh earth from digging). The eggs were 8 cms below soil surface under an acacia bush.

A one metre square chicken wire mesh was pegged down on the nest to keep out predators. During the operation a 2½ metre adult crocodile, possibly the female, kept close by on the water surface.

Nest 2 was located on the south side of the canal. The eggs had been dug up and eaten by predators, the common ones there being mongooses, jackals, monitors, civets.

Subsequently, the Superintending Engineer for the Waterworks wrote us a very interesting letter; that on 2-v-75 at 9-30 a.m. the staff saw a nesting mugger dig a nest hole on the centre bund and lay 22-28 eggs, after which she turned round and started eating them. This has been reported to happen in captive conditions (Ahmedabad Zoo, 1975), but in wild crocodiles this behaviour is difficult to explain.

2) **Elathur, Coleroon (branch of Cauvery River):-** 20-iv-75

Area: A sharp double bend in the Coleroon 12 miles from its entry into the Bay of Bengal has formed a deep channel, where crocodiles were once plentiful. There are several bathing ghats on the south bank of the river.

No. of mugger: Approximately 5.

Nests found: None.

3) **Kilikudi Pond, Grand Anicut:-** 20-iv-75

Area: Two acre pond, ten miles from Trichy. Declared a Crocodile Preserve in 1972.

No. of mugger: 16.

Nests found: Nest 3 was located on the north bank of the pond, 1 metre above and 2 metres from the water line. 20 cm under, the fine clay soil was moist enough to compress into a ball. The nest had 16 eggs, out of which 6 were cracked and 2 rotten. They had been laid around 12-iv-75.

The eggs were transferred to a box and Mr. Rao flew with them to Madras. The cracked eggs failed to develop in the hatchery and were attacked by ants. Four others also turned rotten and on 20-vi-75 only six hatched. One hatchling, which was very weak with a dry skin, died a month later.

4) **Amaravathi Dam (Thennar,, Kuthirayan and Chinnar Streams):-** 22-iv-75

Area: 5 sq km reservoir within the Anamalai Wildlife Sanctuary. Being a drought year the maximum depth was 15 feet.

No. of mugger: Largest single population noted in Tamil Nadu. In one night count 22

animals were observed, and 14 adults in the day time.

Nests found: On a walk around the entire circumference of the reservoir a total of 11 empty nests were seen (nests 4-14). The eggs had been fairly recently removed by humans. Local tribals said that cow herders, stick and dead fish collectors etc. do not hesitate to take the eggs from a fresh mugger nest. These are either sold to the local hotel or eaten at home. All these eggs had been laid during the first two weeks of April. An estimated 350 hatchlings were thus lost to human predation in Amaravathi alone this year.

Remarks: A point of interest about Amaravathi is the fish catch in relation to the number of crocodiles. Having the largest number of mugger in any one habitat in the State, this reservoir also has one of the largest fish catches in India; sometimes one man may catch as much as 350 kg a day, the main fish being *Tilapia peter mozambique*. This situation directly contradicts the popular belief that crocodiles are detrimental to the fish industry. In fact, recent studies in many parts of the world prove the importance and value of crocodilians to Fisheries.

5) **Bhavanisagar, Bhavani and Moyar Rivers:-** 25-iv-75

Area: Large reservoir, present depth 63 feet.

No. of mugger: About 10. 5 were seen by us.

Nests found: No nests located. Much human activity on all shores; fishing, planting, construction etc.

a) **Moyar River**

Area: Moyar River joins Bhavanisagar Dam. Broad stream, thick elephant jungle.

No. of mugger: Not known; very scanty population.

Nests found: None; but local Irulas reported regular nesting sites by a few crocodiles.

b) **Kedarhalli Stream**

Area: Minor tributary of the Moyar which flows down from the Kotagiri Hills through deep narrow chasms. Near Masipatti where the Nilgiri foot-hills start to level out, the stream forms fairly large pools at bends and below falls. There is no road.

No. of mugger: At least 6 breeding size mugger live in pools along the stream. In the 4 km stretch where we camped, we saw 4 adults.

Nests found: Nest 15 was found on the south side of a small pond, 30 feet away from water and 6 feet above water level. The sand was damp $\frac{1}{2}$ metre below the surface. There was no shade nearby, and the nest received direct sunlight from 9 to 4. The eggs had hatched 3 days before and we found the (17) hatchlings in the pond under a huge overhanging rock 50 metres from the nest. The parent had carried hatched and semi-hatched young to the pond. Shells and 2 freshly dead young lay under the boulder. Some of the young had swollen stomachs (unabsorbed yolk) and three had curled tails (over-heating of nest site). Two had raw umbilical scars.

Nest 16 was located near a pool 1 km upstream from here, 40 metres long and 10 metres wide. The average depth was $1\frac{1}{2}$ metres. There was thick mud at the bottom and a large number of fish were dying from clogged gills due to recent rains stirring up the mud. Two adult mugger live in this pool.

15 metres from the pools' edge we saw a slight mound in the bushes, smooth from the passage of a mugger, and wet. Tapping it, we heard soft croaking grunts. In the evening we dug the covering of 25 cms of earth. There were 18 eggs, 11 of which hatched during the next 12 hours. Several were discoloured. The next day these were taken by train to Madras.

Another 3 km upstream, near a slightly

larger pool, we saw nests 17 and 18. The eggs had hatched but there was no sign of the young.

6) **Hogenekal Cauvery River:-** 1-v-75

Area: The Cauvery flows swiftly over a rocky bed with several large, deep pools. This Melgiri area has scrub and deciduous forest, elephant habitat.

No. of mugger: Unknown, a few scattered pairs.

Nests found: Nest 19 was located on a sand bank about 3 metres from the river. The young had hatched about April 21st and on information from local people 23 young were collected.

7) **Sathanur, Ponnaiyar River:-** 3-v-75

Area: Approximately 10 sq mile reservoir, surrounded by dry scrub.

No. of mugger: 10-12 adults.

Nests found: Seven empty nest holes were found (nests 20-26). The eggs had been taken by Irulas and other local people.

Captive breeding at Madras Snake Park

Our 7 feet, 16 year old female laid 22 eggs on 8th March. On 6th May these were transferred to the hatchery. 17 were good eggs, 1 punctured, and four rotten. 15 babies hatched on 24th May. Of these, one was blind in one eye.

Conservation of the mugger: Tamil Nadu has representative examples of the two types of mugger habitat which could contribute to conservation: reservoirs, which could be used for artificial breeding and management (collection of eggs, rearing etc.), and those, like Kedarhalli, which could be excellent wild crocodile preserves in primeval habitat, provided efficient protective measures were taken.

Local tribals would provide ideal staff personnel for crocodile breeding projects, as they have considerable experience and knowledge of nesting habits of mugger through collection of eggs for consumption, besides having a natural aptitude and liking for work involved with wildlife.

Natural hatching of mugger eggs:

After mating, (in India usually between January and March, though timings may change in severe drought conditions, geographically or in captive animals), the female mugger is ready to lay her eggs after about 2 months. Up to five or six trial nests are made, presumably to check suitability of soil temperature, humidity, consistency etc. The final nest has an average depth of 50-60 cms and the average diametre is about 35 cm. Soil above the nest has been found to be between 5 cm and 22.5 cm. The female digs with her hind feet, only sometimes using her front feet. Occasionally she inserts her snout into the hole; this may be checking for fungus, ants, and other undesirable elements. After laying, (anywhere from 16 to 40 eggs, depending on the size and age of the animal) she covers the nest with the fine loose earth she has dug out and packs it with her body. Under normal conditions she visits the nest every night, or lies near or on the site for 24 hours. On every occasion that we found a wild nest, the tracks of the female were clearly visible from the night before. On some of her nightly visits she dampens the nest, either carrying water in her mouth or perhaps by cloacal evacuation (noted by Reuben David, Ahmedabad Zoo). When, 45-47 days later, the babies start their grunting chorus, she gently digs down to the eggs. The hatched and sometimes semi-hatched babies are carried to the water in her mouth.

The protective instinct of crocodiles is very strong. Both males and females react very strongly to the nasal distress cry of the young. Experiments on this with captive and wild specimens have sometimes had rather fright-

ening results, with 3 or 4 large mugger leaving the water and charging open-mouthed at the (human) imitator of the cry.

Artificial incubation and hatching:

Two methods can be adopted. (a) By far the best one is to cover the nest with mesh and have someone keeping constant watch on it.

Hatching success is likely to be far greater this way, as errors in transferring, transporting and duplicating nest site conditions are eliminated. (b) The other method is to transfer the eggs to hatching boxes and transport these to the hatchery. This transfer should be done either within 24 hours after laying or after 20 days. We use wooden boxes 2′ × 2′ × 2′. These should be filled with one layer of earth from the nest site, the eggs placed in it, and re-covered with earth.

The method of transferring the eggs to the boxes is of the utmost importance, and should be done very carefully and slowly. As it is removed from the nest, the top of each egg should be marked with a felt pen, and placed in exactly the same position in the box. If it is turned even slightly, the delicate blood vessels may break and the egg will probably not hatch. The eggs should be tightly packed in a mixture of earth, leaves and grass. The best mode of transport to the hatchery is by train, if the distance is great.

Conditions in hatchery: The hatchery boxes should be placed in an enclosed area. Air and soil temperatures should be taken at the nest site and duplicated inside the hatchery. Careful temperature and humidity checks should be kept. If possible, cracked eggs should be kept in a separate box, as these attract ants. Efforts should be made to eliminate these and other insects.

Hatching: When the babies are ready to hatch, they start making barely audible grunting sounds. 24 hours after the first sounds are heard, at a cool time of day, the earth covering the hatchlings should be dug up. Those still in shells should be allowed to hatch by themselves.

Hatchling enclosure: It is essential to provide an enclosure safe from predators, with clean water, thick vegetation for hiding, and plenty of food.

Food: Young crocodiles eat voraciously from the second or third day. Insects (beetles, termites, dragon-flies, grass-hoppers), small frogs and fish are taken during the first couple of months, up to the first year. A light bulb hung over the pond is a cheap and easy way of seasonally providing some insects. It is important to remember that if there are too many animals put in for food, e.g. frogs, the feeding rate will go down, so also if there are too few. A balance has to be worked out in each case after careful observation. If these basic requirements are provided, hatchlings can grow an at incredible rate. A few of the one year old hatchlings we have are already a metre long.

Acknowledgements

The Tamil Nadu Forest Department has always helped and encouraged us in our work. The Fisheries Department allowed us the use of their rest houses and boats on the reservoirs. Thanks to E. Mahadev and members of the Snake Park who once again took to egg

collection very enthusiastically, and to F. Wayne King, A. C. Pooley and H. R. Bustard for their valuable help, suggestions and criticisms. As always, special thanks to our Irula friends, whose knowledge of natural history puts—or should not put—us all to shame.

MADRAS SNAKE PARK,
MADRAS 600 022,
August 21, 1975.

ROMULUS WHITAKER
ZAHIDA WHITAKER

17. EXTENSION OF THE RANGE OF DISTRIBUTION OF A MICROHYLID FROG [*UPERODON SYSTOMA* (SCHNEIDER)]

The microhylid frog, *Uperodon systoma* (Schneider) (the Marbled Baloon Frog) has so far been recorded from Agra and Allahabad (Uttar Pradesh), Tamil Nadu, S. Kerala and Karnataka (Peninsular India) and Sri Lanka (Thurston 1888; Boulenger 1890; Ferguson 1904; Nieden 1926; Parker 1934; Mahendra 1939; Daniel 1963). Recently, six examples (5♂♂, 1♀) of *Uperodon systoma* (Schneider) were collected from Siwalik hills near Badshahibag (District Saharanpur, Uttar Pradesh) nearly 5 km east of the point where river Yamuna cuts through the Siwalik hills.

The occurrence in the Siwalik hills extends the range of distribution of the species northwards.

A burrowing form, it is found buried under the superficial layer of soil below bushes and stones and is ordinarily not seen because of its nocturnal habits. During breeding season, it visits water holes for laying the spawn. In Siwaliks, it breeds in standing pools of water during the month of July when the pools are filled with rain water.

The species could have a much wider distribution than so far attributed to it has been appropriately pointed out by Daniel (1963). Further thorough surveys might extend its range still further. This record is the first from Siwalik hills and it is likely that the species might also exist in some pockets in the foothills of the Himalayas although Waltner (1974) has not recorded it in the Himalayas.

ACKNOWLEDGEMENTS

We are grateful to the Deputy Director, Incharge, Zoological Survey of India, Calcutta and Officer-in-Charge, Northern Regional Station, Zoological Survey of India, Dehra Dun for encouragement and providing facilities.

ZOOLOGICAL SURVEY OF INDIA,
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71, HAKRATA ROAD, DEHRA DUN,
July 31, 1975.

RAJ TILAK
AKHLAQ HUSAIN

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18. THE SPECIFIC IDENTITY OF THE SOLE, *ZEBRIAS ZEBRA* (BLOCH) IN INDIAN WATERS

Five species namely *Zebrias synapturoides* (Jenkins), *Z. guagga* (Kaup), *Z. altipinnis* (Alcock); *Z. cochinensis* Rao (1967) and *Z. annandalai* Talwar and Chakrapany (1967) of the genus *Zebrias* Jordan & Snyder (Family Soleidae) are so far reported from Indian waters. Of these, the first three species were recorded by Norman (1928) in his revision of flatfishes of India, and he considered Day's (1889) *Synaptura zebra* (Bloch) as the synonym of *Z. guagga*. Chen & Weng (1965), in their review of flatfishes of Taiwan, China, included *Synaptura zebra* under *Zebrias zebra* (Bloch) which they distinguished from *Z. guagga* by the absence of tentacles on eyes.

While Day (1889) in his account of *S. zebra* mentioned that barbels on eyes are present in some specimens, Norman (1928) pointed out that his specimens of *Z. guagga* from Persian Gulf lacked orbital tentacles and had different form and arrangement of cross bars. This suggests that the description of *S. zebra* of Day and that of *Z. guagga* of Norman, in each case, pertained to a composite species.

In the course of identification of flatfish from west coast of India, I came across two specimens of sole (*Zebrias*) measuring 125.0 and 137.0 mm in total length, collected off Jaigad coast, Ratnagiri District, Maharashtra. Except for the absence of orbital tentacles these specimens agree well with Day's description of *Synaptura zebra*. The scales are strongly ctenoid and each possesses 10 to 12 short spinules on the posterior edge.

As the occurrence of *Z. zebra* in Indian waters is re-established it would seem reasonable to believe that Day's (1889) specimens of *S. zebra* with barbels and Norman's (1928) specimens of *Z. guagga* without barbels represented *Z. guagga* and *Z. zebra* respectively.

ACKNOWLEDGEMENTS

I am thankful to Dr. B. K. Tikader, Deputy Director, for providing facilities and to Dr. M. Babu Rao for useful discussions.

G. M. YAZDANI

ZOOLOGICAL SURVEY OF INDIA,
WESTERN REGIONAL STATION,
POONA - 5,
September 23, 1975.

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19. REACTION OF TWO SALTICID SPIDERS TO A BRIGHT PATCH OF LIGHT

In the afternoon at about 2 P.M., my son was sitting idly in an arm chair fiddling with a hand mirror. The sunlight coming from the window was reflected from the mirror as a bright circular patch on the ceiling. He suddenly drew my attention to the antics of a spider clinging to the ceiling next to the reflected circle of sunlight. When the light patch was moved a few inches in front, the spider followed the patch. He moved it to the sides and then to the rear. Each time the spider followed the light patch on the ceiling. Taking the mirror from him I manoeuvred the light patch in all possible directions and angles upto a few feet from the spider. The spider turned, faced and followed the patch every time. After watching its antics for a couple of minutes I collected and preserved the spider for identification.

Next day we noticed another spider on the wall of the bed room and repeated our manoeuvres with the light patch. This spider too repeated the behaviour pattern of the earlier spider of following the light patch. This spider too was collected and preserved.

I sent both the spiders to my friend Dr. B. K. Tikader, Deputy Director, Zoological Survey of India, Western Regional Station, Poona for identification. He has very kindly sent me the following identification:—

Family SALTICIDAE

1. *Marpissa dhakuriensis* Tikader 1 ♀
2. *Marpissa mandali* Tikader 1 ♀

B. S. LAMBA

ZOOLOGICAL SURVEY OF INDIA,
13, SUBHAS ROAD,
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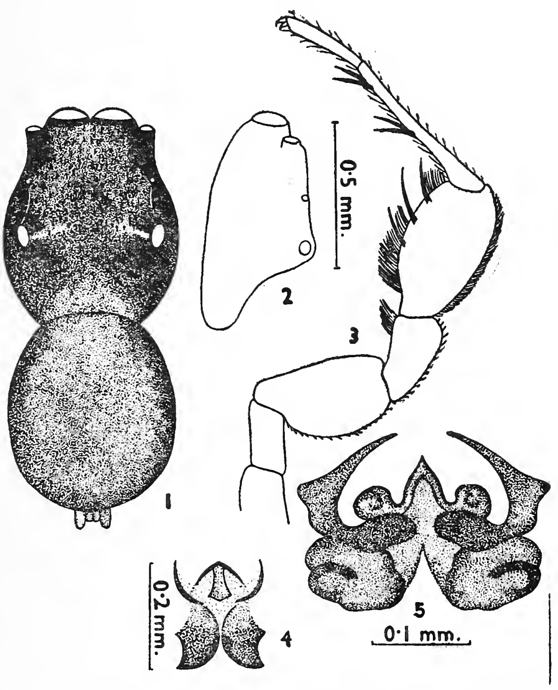
November 6, 1975.

20. REDESCRIPTION OF A JUMPING SPIDER *HARMOCHIRUS BRACHIATUS* (THORELL) WITH A NEW RECORD FROM INDIA
(*With five text-figures*)

INTRODUCTION

While studying the jumping spiders of India, I came across several specimens of the species *Harmochirus brachiatus* (Thorell) from Poona, Maharashtra, India. These specimens have been deposited in the Collection, Zoological Survey of India, Western Regional Station, Poona and part of the collection will be deposited in due course in the National Zoological Collection, Zoological Survey of India, Calcutta.



Figs. 1-5. *Harmochirus brachiatus* (Thorell)
1. Dorsal view of male, legs omitted; 2. Lateral view of cephalothorax of male; 3. First leg; 4. Epigyne; 5. Internal female genitalia.

A review of the literature reveals that the species is a rare one and only known from Sri Lanka and Celebes (Thorell 1890) and from Japan (Yaginuma 1960). This species is not recorded from the Indian sub-continent. The present note is intended to place on record the actual occurrence of the species of *Harmochirus brachiatus* (Thorell) from the Indian sub-continent. Since no detailed description and illustration of this species is available, a redescription and illustration of this spider is given below:

DESCRIPTION

Cephalothorax and abdomen deep brown colour. Total length 3.50 mm, Cephalothorax 2.00 mm long, 1.50 mm wide; abdomen 1.80 mm long, 1.40 mm wide. Cephalothorax very high and cephalic region flat. Posterior eyes situated on an elevated tubercle. Legs light to deep brown. First pair of legs conspicuously robust and long; femur and tibia of I legs remarkably expanded. Tibia of I provided ventrally and dorsally with a row of fringe hairs. Tibia and metatarsi of I provided with three and two pairs of robust ventral spines respectively. Abdomen oval or nearly elliptical in shape, clothed with fine pubescence. Epigyne as in text-figs. 4, 5.

REMARKS

Harmochirus brachiatus (Thorell) is easily recognisable from any other form recorded, by the shape of the body, 1st pair of legs,

shape of female epigyne and male palp. These are very small spiders living on the ground among debris. The movement of these spiders is very peculiar in that while walking, they always keep the first pair of legs turned up for purposes of defence.

ACKNOWLEDGEMENTS

I am thankful to Dr. S. Khera, Deputy Director-in-Charge, Zoological Survey of India, Calcutta for providing some rare literature on jumping spiders and to Dr. P. Merrett for going through the manuscript and for suggestions.

B. K. TIKADER

ZOOLOGICAL SURVEY OF INDIA,
WESTERN REGIONAL STATION,
POONA - 5,
October 23, 1975.

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21. BEHAVIOUR OF DRAGONFLIES

About 14.00 hrs on 24 August, on the top of Kanheri hill near Bombay (*c.* 500 m), a dragon-fly, disturbed by my approach, flew from one strobilanthus leaf to another a few yards ahead, and then to another. I had stopped to watch it when a second dragon-fly, with a white dot at the end of its tail, landed on the same leaf, behind the first one but facing in the other direction, and immediately the two insects coupled. Probably there had been some aerial pursuit which I did not see, but on the leaf there were no preliminaries. I watched for five minutes, during which time the only movement was that the second insect slewed around so that instead of being in a straight line the coupled bodies formed a widely-opened U. Then I moved off, and five minutes later the insects had disappeared.

It was a cloudy, windy day but no rain had fallen for some hours, and the nearest standing water was about a kilometre away. As only the tips of the tails were in contact the behaviour would not seem sexual in character. In DRAGONFLIES, Philip S. Corbet says 'most dragonflies spend the first two weeks of life away from water attaining sexual maturity' (p. 105) but I cannot see any reference to contact between dragonflies on the ground and wonder if such behaviour is typical and often seen.

R. E. HAWKINS

56 VALENTINA,
5 GAMADIA ROAD,
BOMBAY 400 026,
November 14, 1975.

22. FOOD PREFERENCES IN THE LARVAE OF TWO MOTHS: *SPODOPTERA LITURA* F. (FAM. NOCTUIDAE) AND *DIACRISIA OBLIQUA* WALK. (FAM. ARCTIIDAE)

I would refer to Asha Bassi's paper under the above title [1974, *J. Bombay nat. Hist. Soc.* 71(1):161-163].

In the first place I would query the term 'usual' food-plant for Cauliflower in regard to *Spodoptera litura* F. In my paper "The Food-plants of Indian Agaristidae and Noctuidae (1941, *J. Bombay nat. Hist. Soc.* 42:421 et seq.) I listed seven food-plants for this species, and in a later supplementary paper (1949, *J. Bombay nat. Hist. Soc.* 48:265 et seq.) I added a further sixty-five, ranging from trees to herbs and including both Mono- and Dicotyledons. In a paper now in course of publication I have listed twenty-seven food-plants for its African counter-part *Spodoptera littoralis* Bsd. Obviously both species are highly polyphagous, and doubtless many more food-plants remain to be discovered.

Secondly, I do not consider that the quoted figures of weights can be used as a basis for any useful comparison. The amount of moisture in the frass varies from food-plant to food-plant, and also with the length of time between evacuation and weighing, when dealing with the same species, whilst different species of larvae may lose moisture through their spiracles at differing rates, resulting in a greater or lesser amount present in the frass at the time of evacuation.

As regards the difference in the lengths of larval life in the two species, it is normal for *Diacrisia* spp. to have a longer larval life than Noctuids, the length of the individual instars is greater and Arctiids have more of them.

MOMBASA,
KENYA,
October 23, 1975.

D. G. SEVASTOPULO

23. ON THE OCCURRENCE OF THE HOODED GRASSHOPPER, *TERATODES MONTICOLLIS* GRAY AT ALIGARH

The Hooded grasshopper is an important pest of Teak, *Tectona grandis* Linn. distributed in Western and Southern India. It has also been reported from Bihar, West Bengal, Orissa, Mysore, Madhya Pradesh etc. [*J. Bombay nat. Hist. Soc.* 63 (1):212-213, 1966].

Recently during the month of July 1975 a few specimens of the Hooded grasshopper, *T. monticollis* were recorded from Aligarh Scindia Fort (lat. 27° 34′ 30″N, long. 78° 4′ 26″E) feeding upon plants which are hitherto not recorded as their food plants. These plants were identified as:

PLANT	FAMILY
1). *Heliotropium eichwaldi*	BORAGINACEAE
2). *Solanum nigrum*	SOLANACEAE
3). *S. melongena*	”
4). *S. tuberosum*	”
5). *Datura* sp.	”
6). *Saccharum officinarum*	GRAMINEAE
7). *Arundo donax*	”
8). *Lagenaria vulgaris*	CUCURBITACEAE
9). *Momordica charantia*	”
10). *Ricinus communis*	EUPHORBIACEAE

A preliminary observation on the feeding potential reveals that this grasshopper may be considered as a pest of some important plants in this part of the country. Among the food plants enumerated above, the plants belonging to the family Solanaceae were preferred by the grasshopper to other plants. The grasshopper could not be reared in the laboratory due to some unknown microbial infection in the collected specimens.

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September 7, 1975.

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24. STUDIES ON THE WATER BUGS (HEMIPTERA: HETEROPTERA) OF CORBETT NATIONAL PARK

The Corbett National Park in Uttar Pradesh occupies an area of 525 sq km in the foothills of the Himalayas. The collections were made by survey parties of Northern Regional Station, Zoological Survey of India, Dehra Dun, from small pools with fresh running water by the sides of the river Ramganga and its tributaries. These pools apparently had no water plants and were seldom more than a foot in depth. The collecting stations within the Corbett National Park were; (Districts—Nainital and Pauri Garhwal).

District Naini Tal: Bij Rani, Jamnagawar, Malani, Mohan and Sultan.

District Pauri Garhwal: Boxar, Dhikala, Dhulwasote, Gairal, Kanda, Paterpani and Sarpduli.

Eight species of water bugs belonging to the families, Hydrometridae, Naucoridae and Nepidae have been recorded from the park. Most of these agree fairly closely with the descriptions by Distant (1903, 1906), but in a few cases marked differences have been observed and noted.

Family HYDROMETRIDAE

Subfamily Gerrinae

Gerris sahlbergi (Distant)

Material examined: Bij Rani (4).

Agrees with the published description except in the following; Antennae yellowish-brown; eyes bottle-green; lateral margins of the body silvery-grey; pronotum; notum and postnotum brownish-yellow.

Known distribution: Ladak, Leh, Gramphu and Kulti Nal.

Metrocoris stali (Dohrn.)

Material examined: Dhikala (3), Dhulwasote (2), Malani (6), Mohan (6), Sarpduli (37) and Sultan (1).

Antennae light brownish-yellow; in some specimens both longtitudinal black spot of the

posterior area of the pronotum meet together and form a semicircular line. Hemelytra brown.
Known distribution: Bombay, Nilgiri Hills and Sri Lanka.

Ptilomera laticaudata (Hardwicke)
Material examined: Bij Rani (18); Dhulwasote (5); Gairal (60); Malani (18); Mohan (46); and Sarpduli (40).

Agrees with the published description except that a narrow black line is present on the lateral sides of the body.
Known distribution: Dehra Dun, Kalsi, Nilgiri Hills, Sri Lanka, Burma and Malaya.

Family NAUCORIDAE
Subfamily Laccocorinae

Heleocoris ovatus Montandon
Material examined: Bij Rani (25); Boxar (2); Gairal (4); Dhulwasot (3); Malani (3) and Sultan (1).

Rostrum brownish-yellow, hemelytra black and yellow laterally.
Known distribution: Dehra Dun, Hoshiarpur and Hamirpur.

Heleocoris obliquatus Spin.
Material examined: Bij Rani (14); and Dhikala (2).

Rostrum yellow; eyes black; scutullum dark-brown.
Known distribution: Bombay.

Family NEPIDAE

Laccotrephes ruber (Linn.)
Material examined: Bij Rani (10); Boxar (3); Dhela (1); Dhikala (1); Gairal (2); Jamnagawar (2); Malani (1); and Paterpani (19).
Known distribution: Dehra Dun, Bombay, Calcutta, Kashmir, Kangra valley, Naga Hills, North Khasi Hills, Burma, Borneo, Sri Lanka, China, Formosa and Japan.

Ranatra filiformis (Fabricius)
Material examined: Paterpani (2).

Rostrum yellow with black tip; pronotum light brownish-yellow and anterior femora pale-yellow.
Known distribution: Bihar.

Ranatra veripes (Stal.)
Material examined: Dhikala (1); Kanda (1); Paterpani (1); and Sultan (2).

Eyes black: rostrum and hemelytra brownish-yellow.
Known distribution: Bengal, Dehra Dun, Burma, Sri Lanka and Nepal.

ACKNOWLEDGEMENTS

I am grateful to Dr B. S. Lamba, Deputy Director & Dr Asket Singh, Suptd. Zoologist, Zoological Survey of India, Dehra Dun, for providing facilities to carry out this work. Thanks are also due to the Chief Wild Life Warden, Uttar Pradesh and the Wild Life Warden, Corbett National Park, for help extended to the Survey parties in the collection and study of the material.

MAHABIR PRASAD

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NORTHERN REGIONAL STATION,
DEHRA DUN, (U.P.),
September 7, 1975.

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25. ON AGGRESSIVENESS IN THE MALES OF BROWN CRICKET, *GRYLLODES SIGILLATUS* WALKER (ORTHOPTERA: GRYLLIDAE)

Alexander (1961)[1] described aggressiveness as a sequel of sexual behaviour in field crickets. While working on the sexual behaviour of the common brown cricket, *Gryllodes sigillatus,* we were able to record the following observations.

When females are scarce, males become aggressive in order to secure the females and fighting males back up, and lash and kick each other with their hind legs. The fight generally lasts about 10 minutes. Meanwhile the female remains hidden. If the fight is prolonged both become more fierce and aggressive, and after about 15 minutes become exhausted. The fight is interrupted occasionally with intervals lasting about five seconds.

As soon as one of the males becomes inactive, the other takes the opportunity of nibbling or even chopping off the antennae of the rival cricket and subduing it. At times, the femur may be chewed and with this deformity the already mutilated male runs and is chased by the winner.

During such a fight over a female, the males invariably stridulate and grapple each other. Subsequently the winning male mates.

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26. OCCURRENCE OF *HETERONYNCHUS* SP. (COLEOPTERA: SCARABAEIDAE) ON PADDY IN SOUTH INDIA

Heteronynchus sp. (Coleoptera: Scarabaeidae) has been reported from North India as a pest of paddy seedlings (Chhoteysingh 1964)[1]. Recently we recorded its occurrence on paddy in South India on the farms of Regional Research Station, Dharwar and Agricultural Research Station, Mugad, Dharwar District, University of Agricultural Sciences, Dharwar, Karnataka State. Over twenty-five acres of rice was damaged at a stretch by the pest in Mugad farm. The damages was localized in Regional Research Station, Dharwar. Similar reports were also received from paddy cultivators of Dharwar District.

The adult beetles damaged the crop. The incidence of the pest was 80 per cent and it was found on crop of all age groups from June to September, 1974. However, the incidence of the pest was heavy on seedlings and the crop of vegetative stage. The crop of other stages suffered little from the attack. The pest was severe on drill sown rainfed paddy and crop raised in areas of scant water resources. The adult beetles remained under ground very close to the root zone and cut at the collar of the plant; as a result the affected plants turned white and non ear bearing. In severe cases the entire clump dried up. A maximum of 10 beetles and a minimum of two were noticed per clump. To ascertain the nature of damage and symptoms of damage caused by the pest, adult beetles were enclosed with healthy seedlings planted in a cylindrical jar and observations were made. The nature of damage and symptoms observed on the plant were almost similar to the damage and symptoms observed in the field.

Further, studies on the biology, behaviour and control of the pest are in progress.

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August 4, 1975.

PUTTASWAMY
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[1] CHHOTEYSINGH, BHATULA (1964): The devourer of paddy seedlings. *Indian Fmg.* *14*(8):18.

27. ADDITIONS TO THE APHID FAUNA OF BIHAR WITH THE FIRST RECORD OF AN APHID SEXUALE (HOMOPTERA: APHIDIDAE)

Bose & Ray (1968), Fletcher (1920, 1930), Lefroy (1909), Raychaudhuri (1956), Sen & Ray (1966) and van der Goot (1971) recorded 14 species belonging to 9 genera from Bihar. Subsequently, Ghosh (1970) reported from Chotanagpur another 14 genera of which 10 were different from the previously mentioned 9 genera. The present note is based on the aphid specimens collected chiefly from the Netarhat hills (*c.* 1000 m). Examination

of the material reveals the existence of 14 other species belonging to 11 genera (including 3 previously recorded genera) and these are all new additions for Bihar. As a result, the total number of species known from Bihar now stands at 42 under 27 genera. In addition, oviparous form of *Rhopalosiphum maidis* (Fitch) is reported for the first time from the area. Incidentally, it may be stated that beside the sexuale mentioned above, no other sexuale of any aphid species had been known to occur in Bihar. The present note lists the newly recorded species with relevant data for each species. A description of the sexual form of *R. maidis* is also provided.

All the material was collected by me and is in the Zoological Survey of India, Calcutta.

LIST OF SPECIES

Aphis gossypii/nasturtii group: Apterous viviparous ♀♀, National Park, Hazaribagh, 28-x-1969.

Aphis speraecola Patch: Alate viviparous ♀♀, on undet Compositae, Ranchi, 10-ii-1968.

Aphis fabae solanella Theobald: Apterous viviparous ♀♀, on *Solanum nigrum*, Marhan Farm, Hazaribagh, 29-xi-1968.

Astegopteryx bambusae (Buckton): Apterous viviparous ♀♀, on *Bambusa* sp., Darbhanga, 25-xi-1969.

Note: Only a few apterous adults and nymphs were found occurring along the midrib of the under surface of leaf of the host plant. Coccids were also found in the vicinity and attendant ants were noticed in association.

Capitophorus hippophaes indica Ghosh & Raychaudhuri: 2 apterous viviparous ♀♀ and nymphs, on *Polygonum hydropiper*, Ranchi, 10-ii-1968.

Gocica lucifuga (Zehnt.): Many apterous viviparous ♀♀, on roots of *Cyperus* and *Oryza sativa*, Hazaribagh, December, 1968.

Schizaphis cyperi van der Goot: Apterous viviparous ♀♀, on *Cynodon dactylon*, Darbhanga, 5-vii-1969.

Macrosiphum (*Sitobion*) *rosaeiformis* (Das): Apterous viviparous ♀♀, on *Rosa* sp., Netarhat Hills, November, 1969.

Hyperomyzus lactucae (Linnaeus): 2 apterous viviparous ♀♀, on Compositae, Netarhat, November, 1971.

Myzus ornatus (Laing): 4 apterous viviparous ♀♀ on undet Compositae, Netarhat, November, 1969.

Myzus cerasi (Fabricius): Apterous viviparous ♀♀, undet Euphorbiaceae, Netarhat, November, 1971.

Macromyzus polypodicola (Takahashi): Many apterous viviparous females, on *Cheilanthes farinosa*, Netarhat, September, 1971.

Note: This aphid is readily recognised by its yellow body with black siphunculi and is usually found on undersurface of the leaf. Mostly apterous colonies were found.

Micromyzus nigrum van der Goot: Many apterous viviparous ♀♀, on *Cheilanthes farinosa*, Netarhat, November, 1971.

Therioaphis sp.: One alate viviparous female, "on wing", Sabour, Bhagalpur, March, 1971.

Rhopalosiphum maidis (Fitch)

APTEROUS OVIPAROUS FEMALE:

Morphological characters: Body oval, short, 1.53 mm long with maximum width 0.78 mm near the middle of abdomen; rather hyaline except head, the two basal antennal segments, a.s.v. and vi, whole of 3rd and 4th rostral segments, all coxae and trochanters, tibial apices of front and middle legs, whole of femora and hind tibiae, tarsi, siphunculi, sub-genital and subanal plates, cauda, spiracular sclerites dark brown. Median frontal prominence not developed, smooth. Antennae a little longer than half the length of body, six segmented, processus terminalis about 4.3 times as long as the base of segment VI and twice as long as segment III. Longest hair on segment III about less than half of basal width of antennal segment III. Rostrum reaches mid coxae; apical segment about twice as long as its width at base and just longer than the second joint of hind tarsus, with two secondary hairs. Dorsal abdominal hairs sparse, small, about only 6 μ. 8th tergite with 2 fine hairs (about 15 μ). Abdominal tubercles indistinct. Siphunculus

subcylindrical, two and a half times as long as its basal diameter, strongly imbricate, with poorly developed apical flange. Subgenital plate with about 13 pointed hairs on each pigmented area. Anal plate rounded, with 5 long slender, slightly curved and pointed hairs on each side. Egg (single in *situ*) ovoid and about 90 μ in diameter. Cauda about 1.4 times as long as its basal width, broadened at base and gradually narrowed apically, 0.8 of siphunculi and bears 5 curved long and pointed hairs. Legs relatively shorter than those of apterous viviparous females. Hairs on hind tibiae short (12 μ - 30 μ) stiff, thorny, about half as long as the maximum width of the hind tibiae, with numerous subcircular small pseudosensoria (maximum diameter 9 μ), scattered irregularly almost over the entire length except the base and apex. F.t.ch. 3, 3, 2.

Measurements (in mm): Length of body 1.53; antenna 0.949; segment III, 0.169; IV 0.130; V 0.117; VI 0.078 + 0.338; u.r.s. 0.091; second joint of hind tarsus 0.078; siphunculi 0.130; cauda 0.104.

Material examined: Many apterous oviparous ♀♀, on *Pyrus communis*, Netarhat, March, 1971.

Remarks: Menon & Ghai (1969) recorded the oviparous female of *Rhopalosiphum maidis* (Fitch) on wheat from Delhi. Although oviparae under report agree with major characters of *R. maidis* (Fitch), yet they show morphological difference in having longer processus terminalis which is a little over 4 times its base. But whether this variation is consistent enough to deserve altogether different species of *Rhopalosiphum* Koch, can only be ascertained by the examination of further material including viviparous females from the same host and area. It is, therefore, being reported for the present as ovipara of *R. maidis* (Fitch) till more material is available.

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28. ODONATA (INSECTA) OF CORBETT NATIONAL PARK (UTTAR PRADESH, INDIA)

The Corbett National Park situated in the foot hills of Himalayas (Naini Tal and Pauri Garhwal district) has numerous small streams flowing into the River Ramganga. Visitors to the park often see large swarms of dragonflies and in the neighbourhood of the streams. Systematic collection and study of dragonflies from the park by survey parties of the Zoological Survey of India have recorded the occurrence of 37 species of dragonflies, 14 belonging to the Suborder Zygoptera and 23 to the Suborder Anisoptera. Most of the species agree fairly well with the description of Fraser (1933, 1934 and 1936) but in a few cases marked differences have been observed and noted.

Suborder Zygoptera
Superfamily Coenagrioidea
Family PLATYSTICTIDAE
Subfamily Caconeurinae

Caconeura autumnalis Fraser

Postnodal nervures vary from 13 to 14 in the fore wing and 11 to 12 in the hind wing.

Material: 3♂♂, 1♀.

Family PLATYCNEMIDIDAE
Subfamily Platycnemininae

Copera marginipes (Rambur)

Nine postnodal nervures in the hind wing.

Material: 31♂♂, 15♀♀.

Family COENAGRIIDAE
Subfamily Pseudagriinae

Pseudagrion rubriceps Selys

Material: 5♂♂, 3♀♀.

Subfamily Ischnurinae

Ischnura forcipata Morton

It has 7 to 8 postnodal nervures in the hind wing.

Material: 47♂♂, 24♀♀.

Ischnura delicata (Hagen)

Proximal half of the pterostigma in hind wing is rose-red while its distal half is almost colourless.

Material: 3♂♂, 14♀♀.

Rhodischnura nursei (Morton)

Material: 2♂♂, 1♀.

Aciagrion pallidum Selys

Labium is creamy white in the female, and antennae up to 2nd segment are brownish in colour in both the sexes.

Material: 5♂♂, 5♀♀.

Subfamily Agriocneminae

Agriocnemis clauseni Fraser

It has 8 postnodal nervures in the hind wing.

Material: 8♂♂, 13♀♀.

Agriocnemis pygmaea (Rambur)

Material: 2♂♂, 1♀.

Superfamily Lestinoidea
Family LESTIDAE
Subfamily Lestinae

Lestes viridula Rambur

Material: 75♂♂, 86♀♀.

Family CHLOROCYPHIDAE

Rhinocypha quadrimaculata Selys

Discoidal cell is traversed 3 to 5 times, antenodal nervures are 15 to 19 in male and 14 to 17 in the female.

Material: 31♂♂, 10♀♀.

Rhinocypha bifasciata Selys

Head totally black, prothorax has a spade-shaped cream yellow mid-dorsal longitudinal spot on its posterior lobe, discoidal cell is traversed 4 times, antenodal nervures 20 in number, first three abdominal segments have somewhat rounded yellow spots on their lateral

sides. This species has been recently reported from North-West India (Singh & Prasad, *in press*).
Material: 2♂♂.

Labellago lineata lineata (Burmeister)
Pterostigma in hind wing is yellowish and bordered by black nervures, 6 to 7 antenodal nervures are present in the fore wing and 11 in the hind wing.
Material: 1♂, 1♀.

Family AGRIIDAE
Subfamily Agriinae

Neurobasis chinensis chinensis (Linn.)
Material: 10♂♂, 12♀♀.

Suborder Anisoptera
Superfamily Aeshnoidea
Family GOMPHIDAE
Subfamily Gomphinae

Mesogomphus lineatus (Selys)
Material: 1♂, 4♀♀.

Superfamily Libelluloidea
Family LIBELLULIDAE
Subfamily Tetratheminae

Tetrathemis platyptera Selys
Material: 1♂.

Subfamily Libellulinae

Cratilla lineata (Brauer)
Material: 1♀.

Orthetrum taeniolatum (Schneider)
Material: 21♂♂, 28♀♀.

Orthetrum chrysostigma luzonicum (Brauer)
The middle portion of labium is black, 2 rows of cell are present in between the IRIII & RSPL.
Material: 29♂♂, 21♀♀.

Orthetrum sabina (Drury)
Material: 29♂♂, 18♀♀.

Orthetrum triangulare triangulare (Selys)
Labium totally black, postclypeus brownish black, the blackish brown triangular spot in the hind wing extending up to 2nd antenodal nervures; membrane brownish black; discoidal cell in fore wing, 2 celled; 4 to 5 cells are present in the subtrigone in the fore wing.
Material: 1♂.

Orthetrum japonicum internum MacLachlan
Pterostigma extends over more than 2½ cells; but less than 3 cells; reticulation of the wing incomplete; development of 6th antenodal nervure is incomplete.
Material: 50♂♂, 32♀♀.

Orthetrum glaucum (Brauer)
Distal border of the labium is black; labrum is totally black; pterostigma covers 2½ cells and membrane is brown.
Material: 143♂♂, 44♀♀.

Orthetrum pruinosum neglectum (Rambur)
Arc is situated on the 2nd antenodal nervure in the fore wing.
Material: 80♂♂, 14♀♀.

Subfamily Diastapidinae

Palpopleura sexmaculata sexmaculata (Fabricius)
Occiput is brownish-black; fore wing is tinted with yellow from base to pterostigma; cubital stripe extends up to the anterior half of the discoidal cell.
Material: 49♂♂, 42♀♀.

Subfamily Sympetrinae

Acisoma panorpoides panorpoides Rambur
Material: 1♀.

Diplacodes nebulosa (Fabricius)
Material: 1♀.

Diplacodes trivialis (Rambur)
Material: 2♂♂.

Crocothemis servilia servilia (Drury)
Material: 136♂♂, 122♀♀.

Neurothemis fulvia (Drury)
Material: 2♂♂, 1♀.

Brachythemis contaminata (Fabricius)
Material: 1♀.

Sympterum commixtum (Selys)
Margins of labrum and occiput are black; membrane is blackish-brown.
Material: 1♂.

Subfamily Tritheminae

Trithemis aurora (Burmeister)
Material: 30♂♂, 25♀♀.

Trithemis festiva (Rambur)
Material: 133♂♂, 25♀♀.

Trithemis pallidinervis (Kirby)
Middle lobe and margins of lateral lobe of labium black; anal appendages reddish-yellow at the base.
Material: 1♂, 1♀.

Subfamily Pantaliinae

Pantala flavescens (Fabricius)
Material: 44♂♂, 22♀♀.

Tramea virginia (Rambur)
Recently recorded from India for the first time (Singh & Prasad, *in press*).
Material: 2♂♂, 1♀.

ACKNOWLEDGEMENTS

We are thankful to the Director, Zoological Survey of India, Calcutta, for providing facilities to carry out this work. Thanks are due to the Chief Wild Life Warden, Uttar Pradesh and the Wild Life Warden, Corbett National Park, for their help extended to the survey parties in the collection and study of the material.

ZOOLOGICAL SURVEY OF INDIA,
DEHRA DUN, (U.P.),
May, 21, 1975.

ASKET SINGH
MAHABIR PRASAD

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SINGH, A. & PRASAD, M. (in Press): New record of *Rhinocypha bifasciata* Selys (Odonata: Zygoptera: Chlorocyphidae) from North-West India.

29. A NEW DISTRIBUTIONAL RECORD FOR *PHYSALIS PERUVIANA* LINN. FROM NORTH GARHWAL

Physalis peruviana Linn. Sp. Pl. ed. 2 (1763), p. 1670. An indigenous species of Tropical America, introduced in the past in India and South Africa. It runs wild as an under growth of forests in the hills of Western and Eastern Ghats. In the plains of India it is generally cultivated in gardens for its bright amber coloured fruits which are either eaten raw or cooked.

I recently surveyed the area of Tharali block in Chamoli District and observed this species growing wild in exposed sandy soils

near Tharali along the right bank of the river Pindar (24-3-74 Nautiyal 4932). It seems that the plant has become naturalized in this part of western Himalayas where it is not under cultivation. Further the distribution of the taxon is not widespread and its migration seems to be more recent within the area.

The taxon is distinguished by solitary, axillary, yellow coloured flowers with a purple ring like spot at the base within the corolla and globose amber coloured berry enclosed by large persistent calyx.

I am thankful to Professor Y. S. Murty for his guidance.

K. N. NAUTIYAL

DEPARTMENT OF BOTANY,
MEERUT UNIVERSITY,
MEERUT,
August 23, 1975.

30. *HYPECOUM PROCUMBENS* LINN.: A NEW RECORD FOR INDIA

The genus *Hypecoum* Linn. (Family Hypecoaceae or Papaveraceae), comprising of about 15 species, is distributed in the Mediterranean region and temperate Asia. Among Parietales (*sensu* Bentham and Hooker), the genus is easily distinguished by its bimerous, regular flowers with the inner 2 petals characteristically deeply 3-parted. In India, hitherto, it was represented by one species, namely, *H. leptocarpum* Hook. f. and Thoms. in Sikkim Himalayas (Santapau & Henry 1973).[1] A few specimens of another species, *H. procumbens* Linn., were gathered from a locality in Punjab. The present report is a south-east extension of the distributional range of the species and the first record of its occurrence in India.

Hypecoum procumbens Linn. Sp. Pl. 124, 1753; Fedde in Engler, Pflanzenreich *40*:87, f. 13 A & P, 1909; Bailey, Stand. Cycl. Hort. 2:1629, 1928.

A glaucous annual. Stems (scapes) 1-3, ascending or becoming decumbent in fruit, 8-21.5 cm long. Leaves radical, rosulate or subrosulate, glaucous-green, 3.5-13.5 cm long, long-petioled, 2-3-pinnatisect, segments very narrow, linear, entire, acute or mucronulate. Floral-leaves whorled, sessile or subsessile, 0.8-3.5 cm long, dissected into linear lobes. Scapes dichotomously divided above with the flowers in branched, dischasil, umbellate cymes up to 7 cm long. Flowers bimerous, symmetrical, pedicelled, 5-8 mm long, bright yellow. Sepals 2, free, much shorter than the petals, ovate or ovate-lanceolate, acute, denticulate along the upper margin, yellow-green, deciduous. Petals yellow, veined, 4, free, in 2 series of 2 each; outer 2 petals somewhat 3-loged but the side lobes very short or obsolete, obovate or oval-oblong, base cuneate; inner 2 petals deeply 3-parted, middle lobe the largest, stalked, elliptic, entire but usually toothed or fringed all-around the margin, obtuse or emarginate; lateral lobes narrow, linear-oblong, with black spots or not, entire, obtuse. Stamens 4, free, opposite the petals; filaments membranous, winged, black-spotted on the edges or not; anthers 2-celled, linear-oblong. Ovary bicarpellary, syncarpous, superior, 1-

[1] SANTAPAU, H. & HENRY, A. N. (1973): A Dictionary of the flowering Plants in India. New Delhi.

celled, ovules 10-14 on 2 parietal plancentas; style short, 2-fid; stigmas obtuse or subcapitate. Capsule 2-4 × 0.2 cm, narrow and siliqua-like, subcompressed, curved with elevated reticulate striations, tapering into a slender beak, glabrous, few-seeded, constricted between the seeds. Seeds plano-convex, yellowish or brownish.

Specimens described: M. Sharma 3965 (PUN).

Locality: Samana (alt. 240 m) in Patiala dist. of Punjab. In cultivated and fallow fields. The species has also been observed in Ludhiana and Faridkot districts and probably also occurs in other drier districts of Punjab.

Flowers and fruits: March-June.

Distribution: Mediterranean region, West Asia, Afghanistan, Pakistan.

English name: Horned cumin.

H. leptocarpum Hook. f. & Thoms. can be easily separated from *H. procumbens* Linn. by its pale purple flowers and the inner petals, mid-lobe of which is oblong and cucullate. The contiguity of Pakistan with Punjab (India) suggests almost with certainty the path of introduction of this newly reported species in India.

I am indebted to Prof. S. S. Bir for encouragement and facilities.

M. SHARMA

DEPATRMENT OF BOTANY,
PUNJABI UNIVERSITY,
PATIALA 147 002,
August 23, 1975.

31. OCCURRENCE OF *SOLANUM INTEGRIFOLIUM* AND *S. GILO* IN NORTHEASTERN HILLS

During surveys in Meghalaya and Manipur in 1972-73 for the collection of plant material of agri-horticultural importance, two red-fruited *Solanum* species were collected. These have been subsequently identified as *Solanum integrifolium* Poir. and *Solanum gilo* Raddi, hitherto not reported from India. Both are considered to be of African origin—*S. gilo* occurring in a naturalised state in many parts of South America.

Solanum integrifolium Poir.—the Chinese scarlet egg-plant (Bailey 1902) is a coarse much branched herbaceous annual upto 80 cm tall, scurfy tomentose and usually armed with sharp spines. It bears lobed leaves much like the egg-plant in size and shape but often more deeply lobed and spiny on the midrib and petiole, with white flowers about 1.50 cm across, in axillary clusters of 2-6; fruit upto 4 cm across, flattened and much compressed, distinctly lobed, usually bright scarlet in colour. The plant is grown by the Khasi tribals of Meghalaya in their courtyards and was collected from Nongstoin and Mawrygkneng (± 1500 m).

The other species *Solanum gilo* Raddi—a herbaceous non-prickly herb is very much similar to the above species from which it can be differentiated by its much globular, pear-shaped fruits borne in groups of 2-4, 3-4 cm across, and its comparatively small white flowers with more deeply lobed petals. This bushy herb is grown by the Manipur tribals in homestead gardens particularly near Ukhrul

(± 1600 m). It was also collected from Motbung near Imphal (± 1000 m) and from Nongstoin in Khasi hills (± 1500 m).

No mention of these species is made in the Flora of Assam (Kanjilal *et al.* 1939) or in any other botanical work (Anon. 1972; Watts 1971). Though the tribals use these semi-bitter fruits as vegetable, it appears that these plants might have been introduced initially as ornamentals chiefly through missionaries. *Solanum integrifolium* in some parts is grown for its scarlet tomato coloured berries. Incidentally, the material could also be of use to breeders and botanists engaged in studies on *Solanum melongena* complex.

Our grateful thanks are due to the Kew authorities for confirming the identity of some of the specimens.

PLANT INTRODUCTION DIVISION,
INDIAN AGRICULTURAL RES. INSTITUTE,
NEW DELHI 110 012,
March 10, 1975.

R. K. ARORA
M. W. HARDAS

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32. *PTERIS ROSEO-LILACINA* HIERON., A NEW RECORD FOR PENINSULAR INDIA

Pteris roseo-lilacina Hieron, is a Chinese (Yunan) species described by Hieronymus based on the collection of *A. Henry* 13222 from the banks of river Papien at Talan. Subsequently, Mehra & Bir (1964)[1] reported this taxon from Teesta (alt. 200 m), Darjeeling, as a new record for India. During a collection of ferns and fern allies from Western Ghats we discovered this interesting species at Ponmudi, Trivandrum District, Kerala State. As this species is not previously known from any region in India other than Darjeeling a report on it is considered desirable. This taxon is closely related to *Pteris aspericaulis* Wall. ex Agardh but the two species can be easily distinguished by the following key.

Stipe scabrous; frond coreaceous, brownish green on drying; apex of pinnule mucronulate; very few spines on the costa only .... *P. aspericaulis* Wall. ex Agardh

Stipe glabrous; frond membranaceous, deep green on drying; apex of pinnule obtuse rounded; spines abundant on costa and costule .... *P. roseo-lilacina* Heiron.

As no description of the taxon is available in any of the Indian publications a full description based on our specimens is provided below. The specimens are deposited in the Central National Herbarium, Sibpur (CAL).

[1] MEHRA, P. N. & BIR, S. S. (1964): Pteridophytic flora of Darjeeling and Sikkim Himalayas. *Res. Bull.* (N.S.) Punjab Univ. *15*:69-181.

Pteris roseo-lilacina Hieron. in Hedwigia **55:** 350, 1914.

Rhizome erect, short, tufted, stipe 25 to 40 cm long, glabrous, glossy, roseo-lilacinous, smooth, grooved 15 to 40 cm long. Frond 40 to 80 cm long, 40-60 cm wide, membranous, deltoid, deeply bipinnatifid, with lower pinnae bipartite, upper pinnae gradually reduced with an apical pinnae like the lateral ones. Pinnae 10-20 cm long, 1.5 to 5 cm wide, sessile, truncate at base, oblong, acuminate apex, lower pinnae petiolate, petiole 3-4 mm long pinna lobed almost to the costa, abundant spines on the costa, spine roseolilacinous, segments nearly at right angle to the costa, oblong, entire, apex obtuse rounded 3.5 m wide, 2.5 cm long, sinus within 1 mm, texture thin, membranaceous, veins close, once-forked; sori continuous along margins of the lobes, not reaching sinus and apex of the lobe. Stipe, rachis and costa are decolourised after drying.

Specimens examined.—Ponmudi (alt. 1100 m), *N. C. Nair* 52601, 52607 (October, 1974).

The plants were growing in a deep ravine on steep slopes under shade of *Euphorbia* sp. This is a very rare species in the area.

BOTANICAL SURVEY OF INDIA,
INDIAN BOTANIC GARDEN,
SIBPUR, HOWRAH 3,
March 3, 1975.

N. C. NAIR
S. R. GHOSH

33. CONTRIBUTIONS TO THE XYLARIACEAE OF WESTERN INDIA—VIII[1]

The paper describes three species of *Xylaria* collected from forests of Western India, of which two are new records to India.

1. **Xylaria longipes** Nitschke

Pyren. Germ. 14 : 1867.

Stromata clavate, with a long and rounded apex. Stipe 6-8 cm long, cylindrical or strap like, with a conical padding at the base, twisted. Fertile part 4-5 cm long, 0.5 cm thick, hollow on drying, surface layer buff coloured. Perithecia large black, embedded, flask shaped, laterally flattened, with papillate ostioles, 800-1200 × 480-600 μ. Ascospores elliptic to navicular, dark brown, with mucilaginous sheath, 10-14 × 4-6 μ.

Collected on wood of *Tectona grandis*, at Borivli National Park, Bombay, by V. Subramoniam, dated 8-ix-1972, deposited in Ajrekar Mycological Herbarium under No. AMH 2412.

Remarks: This constitutes an addition to the Fungi of India.

2. **Xylaria pallida** Berk. & Cooke

J. Linn. Soc. Bot. 15, 395 (1876).

Stromata cylindrical, erect, stipitate, with distinct, short, broadly rounded apex. Fertile part 1-3 cm long, 0.5-0.8 cm thick, surface smooth, covered by cream coloured surface layer with irregular cracks; underlayers black. Perithecia embedded, ostiolate, globose to oval, laterally compressed. Ascospores brown, oval with rounded tips, 10-16 × 4-6 μ.

Collected on wood of *Tectona grandis* at Borivli National Park, Bombay, by V. Subramoniam dated 20-viii-1972 deposited under No. AMH 2413.

Remarks: This is an addition to the Fungi of India.

[1] Contribution No. 528 from the Department of Mycology and Plant Pathology.

3. **Xylaria nigripes** (Klotsch.) Sacc.
Syll. Fung. IX:527 (1891).

Stromata cylindrical or rarely clavate, simple, buff to brown coloured, with smooth crust, tip rounded, surface reticulately cracked exposing black, papillate ostioles. Stipe short, smooth, concolorous, with conical pad at base, bearing one to three fertile clavae. Flesh yellow. Perithecia flask shaped, embedded, with black ostioles. Ascospores 8, dark brown oval to inequilateral with obtuse ends, germ slit straight; 10-14 × 6-8 μ.

Collected on wood of *Tectona grandis* at Borivli National Park, Bombay by V. Subramoniam, dated 8-ix-1972, deposited under No. AMH 1883.

It is interesting to note that all the three species of *Xylaria* were collected from the same host under identical conditions of environment.

ACKNOWLEDGEMENTS

We are grateful to Prof. M. N. Kamat, Head of the Department of Mycology and Plant Pathology, for his deep interest and guidance. Thanks are extended to the Director, M.A.C.S. for facilities.

MAHARASHTRA ASSOCIATION FOR THE CULTIVATION OF SCIENCE,
LAW COLLEGE ROAD, POONA 411 004,
March, 3, 1975.

ALAKA PANDE
V. SUBRAMONIAM

34. THE CLIMBING ORCHID—VANILLA

The genus *Vanilla* (family Orchidaceae) has about 90 species of tall, climbing, branched, orchids scattered over the tropical regions of both hemispheres.

The name Vanilla is derived from a Spanish word Vaynilla meaning a knife from the shape of the capsule. Records show that vanilla essence was used by Aztec Indians of Mexico for flavouring chocolate before America was discovered and its use was adopted by Spaniards. *Vanilla planifolia* Andr. an epiphytic orchid—is indigenous to Tropical America and was introduced in the equitorial belt of the world where it is widely cultivated specially in Java, Borneo, Mauritius, Reunion, Seychelles and Tahiti in the old world and in Hondurus, Costa Rica in the new world. It was probably brought to Europe in 1510 and first described by Hernandez in 1651 and introduced into England in the early 19th century.

Vanilla planifolia is of great economic importance in the tropics as the climate is very favourable for its cultivation on a large scale. The stems are almost cylindrical with a large number of widely and alternately spaced shiny dark green leaves. The flowers are about 4″ in width appear in summer in groups of ten or thirty arranged in a terminal racemose spike without an involucre. The labellum which is yellowish green with a bright yellow spot on the throat protrudes from the greenish white sepals.

Small, silvery green, aerial roots exerted opposite to the leaves help the plant to cling to its host. The heavily branched absorptive roots are found at ground level in a thick layer of decaying humus. The stems of *Vanilla* climb

a considerable height and send aerial roots at all angles to the ground. *Vanilla* roots perhaps represent a transitional stage between the epiphytic and terrestrial forms.

Pollination is effected by humming birds and bees as in some orchids. The flowers do not set fruit if the correct pollinating agent does not appear.

When cultivated for commercial purposes away from its natural habitat, the flowers are pollinated artificially by hand and the best time for it is early morning when the flower expands. When fertilised long green fruits hang down in bunches. The plants fruit when they are about 3 years old and continue to fruit for 30-40 years.

The fruits are to be picked before they are ripe and dry. The best variety of pods are of a very dark chocolate brown or nearly black colour with crystallisation outside.

The peculiar fragrance of vanilla is due to vanillin C8 H8 03. Vanillin is not present in the fleshy exterior of the pod. Besides Vanillin the pods also contain vanillic acid, soft resin, sugar, gum and oxalate of lime.

The fragrant aroma of vanilla is developed through an artificial process at which Chinese are said to be experts.

After harvesting the fruits they are dipped in water for a few seconds and then wrapped in woollen blankets and kept in metal-lined boxes in a damp atmosphere for 24 hours. They are then sun dried for a few days and further dried in the shade for 2-3 months. During this process they lose weight and the dark brown surface becomes covered with a glittering layer of fine crystals. Inside the capsule seeds grow on placenta and ultimately become loosened by fine hygroscopic hairs.

The fruits produced by cultivation are better than the wild ones.

The artificial methods used in curing vanilla by the aid of hot water, sun's heat or artificial heat are intended to hasten maturity to produce uniform ripening throughout its entire length and to prevent splitting of pods.

In Peru the pods are collected and heaped in the shade away from sun and rain, and are then subjected to a sweating process. On warm and fine days such pods are spread out in the morning on woollen blankets and exposed to sun. At mid-day the blanket is folded over the pods and left so for the reminder of the day. In the evening all the pods are kept in air-tight boxes so that they may sweat for the whole night. On cloudy days the pods are made into bundles and with a number of bundles to a bale, wrapped with woollen cloth, and then coated with banana leaves and finally covered by a thick matting sprinkled with water.

The bales containing larger pods are placed in ovens heated to 140°F and when the temperature falls to 113°F bales containing smaller pods are introduced and the oven is closed tightly. After 24 hours the smaller pods are taken out and 12 hours later the larger pods are also taken out. During this process the pods sweat and acquire a fine chestnut colour. Such pods are spread for over two months in the sun and marketed after drying.

Vanilla is a good flavouring essence, largely used in the manufacture of chocolate in confectionary and in perfumery. Records show that like cacao it was first cultivated by Indians who never combined the two to make sweet scented chocolate. Mexican Vanilla is chiefly consumed in USA. Besides *V. planifolia* Andr. there are other species of *Vanilla* which produce commercial Vanilla.

Trees suitable for growing *Vanilla*:

Pterocarpus indicus, Lagerstoemia flos-reginae, Albizzia lebbek, Salmalia malabaricum, Ficus elastica, Jatropha curcus, Croton

triglium, Bixa orellana, etc. Sometimes hardwood posts and bars, also, are used, having resting notches at the top.

Growing vanilla from seeds:

Fully matured pods are allowed to blacken and the seeds after being separated from pods are soaked in alcohol for 24 hours and then thoroughly washed and planted. It is reported that the seedlings grow well in light and friable soil rich in humus. The plants require water throughout the year.

Growing from cuttings:

The plants are propagated by cuttings varying in length from 1 to 2 feet, the longer ones are more satisfactory. These may be planted in the ground or merely tied to a tree so that they are not in direct contact with the earth. They soon send out aerial roots by which the connection with the soil is established. They are usually trained on trees.

Use in medicine:

It is reported that the sticky juice of vanilla brings out blisters in human skin but it is used in the treatment of wounds and as an aromatic stimulant in case of hysteria.

I am thankful to Sri V. S. Agarwal for supplying some valuable information and to Dr. R. B. Ghosh for going through the manuscript. I express my gratitude to Dr. S. N. Mitra for his valuable guidance.

524, Circular Road,
Howrah 2 (W.B.),
August 16, 1975.

K. D. MUKHERJI

35. *LYCOPODIUM COMPLANATUM* LINN.: A NEW RECORD FOR KERALA STATE

While studying the species of *Lycopodium* housed in the herbarium of the Cryptogamic Unit of the Botanical Survey of India, Calcutta, we came across a collection of *Lycopodium complanatum* Linn. from Kerala State. As the species is a new record for that region it is reported here.

Clarke (1880) gives the distribution of the species in the Indian subcontinent as Assam, Khasia, Moflong, Syung and Mumbree and in extra limital distribution as Java, Northern Europe, Asia and America. Baker (1887) does not include India in the distribution of the species. The only authentic record of the taxon, we are aware of from peninsular India is by Chowdhury (1937) who reports that the plant was collected by Levinge from Kodaikanal at an altitude of 2100 m. Levinge's material is in the Central National Herbarium, Sibpur, Howrah (CAL), and, other than this specimen, there is no sheet from South India. It has not been reported from South India by subsequent collectors. It appears that this is a very rare plant in South India.

Lycopodium complanatum Linn. Sp. Pl. 1567, 1753; Schk. Krypt. Gew. t. 163, 1809; Hook. et Bauer, Gen. Fil. 117A, 1842; Spring, Monogr. Lycopod. 101, 1842; Milde, Fil. Eur. 257, 1867.

Roots adventitious arising from the under side of the prostrate portion of the stem. Stem 60-70 cm long, bears erect dichotomous branches, 10-15 cm long and 4.5 mm diameter. Leaves dimorphous, greenish, rigid, simple, arranged in four rows on the stem, lanceolate, base broad, apex shortly acumi-

nate, 3-4 mm in length, median leaves erect, adpressed to the stem. Spike cylindrical small, pale in colour, 4-5 cm long. Bract ovate, shortly cuspidate with dentate margin.

Material examined—Thenmala, Munnar, Idikki District, **T. S. Padmanabhan** A. B, C (December, 1972). Along the road on moist sand-stone.

N. C. NAIR[1]
S. R. GHOSH

BOTANICAL SURVEY OF INDIA,
76 ACHARYA JAGDISH BOSE ROAD,
CALCUTTA 14,
July 3, 1974.

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CLARKE, C. B. (1880): A revision of the ferns of Northern India. *Trans. Linn. Soc.* London, Ser. 2, Bot. *1*:425-619.

[1]*Present address*: Regional Botanist, Central National Herbarium, Botanical Survey of India, Sibpur, Howrah-3 (W.B.).

36. A NEW DISTRIBUTIONAL RECORD FOR *ALTERNANTHERA PUNGENS* H.B. & K. FROM NORTH GARHWAL

Alternanthera pungens H. B. & K. Nov. & Sp. 2:206, 1818; Melvill in Kew Bull. 174, 1958—An indigenous species of tropical America was first collected from Madras in 1913. Since then it has spread fast and is established in Coimbatore, Bangalore, Madras, Bombay, Orissa, Delhi and Dehra Dun.

During a floristic survey of Chamoli district the species was collected from the road side on 15.6.74 (Nautiyal, 3505) from Adibadri (600 m) at a distance of 18 km. from Karanprayag.

This taxon is distinguished by prostrate spreading herbaceous habit; sub-orbicular unequal opposite leaves, Flowers in chaffy compressed auxillary heads.

I am grateful to Professor Y. S. Murty for valuable suggestions.

K. N. NAUTIYAL[1]

DEPARTMENT OF BOTANY,
MEERUT UNIVERSITY, MEERUT,
December 16, 1974.

[1]*Present address*: Dept. of Botany, Gochar Mahavidyalaya, Rampur Manhyaran, Distt. Saharanpur, U.P.

37. PLANT RECORDS FOR MAHARASHTRA STATE FROM CHANDRAPUR DISTRICT—III

In this note a few interesting plants have been listed which are new to the State of Maharashtra. The correct nomenclature of the species, diagnostic characters, exact locality, collector's name, field numbers and critical notes are given. All the specimens cited in the note are deposited in the herbarium of the Western Circle, Botanical Survey of India, Poona (*BSI*).

LINACEAE

1. *Erythroxylon monogynum* Roxb. Cor. Pl. I. t. 88, 1798; Fl. Ind. 449, 1874; Fl. Pres. Madras 1: 127, 1915; Fl. Brit. India 1: 414, 1874.

Shrub or small tree. Leaves small, obovate-cuneate. Flowers white. Fruits green with reddish tinge.

Flowers & fruits: October-February. *Locality*: Sironcha, *Malhotra* 108027; Somanpalli, *Malhotra* 108060.

Common on the road side and sandy soils. Gamble (l.c.) records this plant from North Circars, Deccan and Carnatic in dry evergreen forests. The present record of the species from the deciduous forests of Chandrapur district, extends its distribution further north.

RUBIACEAE

2. *Hedyotis ovatifolia* Cav. Icon. 6: 52, 1801. *Oldenlandia nudicaulis* Roth Nov. Pl. Sp. 95, 1821; Fl. Pres. Madras 1: 602, 1915; Beng. Pl. 2: 409, 1963 (Repr. edn.); Fl. Brit. India 3: 70, 1880.

A herb. Leaves ovate, oblong, 2-4 together at apex of stem. Flowers white with pinkish tinge on peduncled corymbose many flowered inflorescence. Capsule, hemispheric, glabrous.

Flowers and fruits: September-January. *Locality*: Bamni, *Malhotra* 109188; Lakkarkote, *Malhotra* 118781; Khatora, *Malhotra* 122799; Mulcera, *Malhotra* 123124, Repanpalli, *Malhotra* 123313; Wamanpalli, *Malhotra* 123797.

3. *H. umbellata* (Linn.) Lamk. in Wt. & Arn. Prodr. 413, 1834. *Oldenlandia umbellata* Linn. Sp. Pl. 119, 1753; Fl. Brit. India 3: 66, 1880.

A diffused much branched small herb. Stem woody. Leaves usually fascicled linear or almost acicular with recurved margins. Flowers white. Capsule globose, glabrous.

Flowers & fruits: October-January. *Locality*: Bamni, *Malhotra* 109195; Lakkarkote, *Malhotra* 117756.

Usually found growing in moist shady sandy soils.

The present record of the species from Chandrapur district is interesting as it extends its distribution further north and there is possibility of its occurrence in the adjacent States of Madhya Pradesh and Andhra Pradesh.

POACEAE

4. *Paspalum distichum* Linn. Syst. Nat. ed. 10, 2. 855, 1759; Grasses Burma, Ceylon, India and Pakistan, 338, 1960; Fl. Brit. India 7: 12, 1897.

A small creeping grass with ascending branches, roots from lower nodes forming mats. Leaves distichous. Spikelets green in racemes of 4 cm long, upper glume pubescent.

Flowers & fruits: September-December. *Locality*: Mul, *Malhotra* 134615.

A rare herb growing in the marshy areas near ponds and puddles. This plant has been

earlier recorded from Malabar (South India), Ganganagar (Rajasthan) and Bahraich (U.P.). The present record of this plant in such dry deciduous forests of Chandrapur district (Maharashtra) indicates the possibility of locating this taxon in the surrounding deciduous forests and hilly tracts.

ACKNOWLEDGEMENT

We are thankful to the Director, Botanical Survey of India, for providing the facilities.

BOTANICAL SURVEY OF INDIA,
WESTERN CIRCLE, POONA-1,
December 2, 1974.

S. K. MALHOTRA
S. MOORTHY

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PRAIN, D. (1963): Bengal plants. Vol. I & II. (Reprinted) Calcutta.

38. A NOTE ON *ENKIANTHUS HIMALAICUS* HOOK. F. ET THOMS. (ERICACEAE)

In course of identification of some sheets in the *Herb. CAL*, we came across some specimens of the taxon which form a new record of distribution for Assam and NEFA in the Eastern India. The collection was mainly from Aka hills (Assam) by Dr. N. L. Bor which was not included in his list of Aka hill (Assam) plants published in *Indian Forest Records* 3(1), 1941. Hence the report of this taxon from Aka hills shows its extended distribution in Assam including NEFA.

Enkianthus himalaicus Hook. f. et Thoms. in Hook. Kew Journ. 7:126, t. 3 (Ic bona) 1855.—Hook. f. in Bot. Mag. t. 6460. 1879. —C. B. Clarke in Hook. f. Fl. Brit. Ind. 3: 461, 1882; *Rhodora deflexa* Griff. Itin. notes 2:187, No. 969, 1848.

A bush or small tree, sometimes 6 m tall. Leaves mostly in terminal clusters, obovate or elliptic, entire or serrulate, narrowed at both ends, acute or obtuse, pubescent beneath when young. Peduncles 2.5—5 cm long, about 10, 1—(rarely 2—) flowered, hairy. Flowers reddish orange in terminal, umbellate or subcorymbose, pendulus or cernuous. Capsule globose, glabrous. Seeds ellipsoid.

Specimen examined: ASSAM: Aka Hills, *Bor* 1843 (CAL).

Distribution: Himalaya, China, Japan and Cochinchina.

ACKNOWLEDGEMENTS

We are grateful to the Director, Botanical Survey of India, for encouragement and to Deputy Director, Central National Herbarium, for help in course of identification.

BOTANICAL SURVEY OF INDIA,
CENTRAL NATIONAL HERBARIUM,
HOWRAH-3,
December 17, 1974.

R. B. GHOSH
R. N. BANERJEE

Volume 72(3): December 1975

Miscellaneous Note 29

Syzygium cuminii (Linn.) Skeels var. *axillare* comb. nov.

ERRATUM

On page 882, line 13

For phyllifolia Lam. var. *axillare* Gamble.
read "phyllifolia Lam.
— var. *axillare* Gamble."

ADDENDUM

On page 883, line 15

For var. *axillare* (Gamble) Tenjarla *et* Kashyapa.
read "var. *axillare* (Gamble) Tenjarla *et* Kashyapa syn.
S. jambolanum DC. var. *axillare* Gamble."

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Further records of *Myotis peshwa* (Thomas 1915) (Chiroptera : Vespertilionidae) from the Indian Peninsula[1]

J. E. Hill
Department of Zoology, British Museum (Natural History), Cromwell Road, London SW7 5BD

There are few records of bats of the genus *Myotis* from central and southern India or from Sri Lanka and no more than three forms have been reported from that area. One, *Myotis montivagus peytoni* Wroughton & Ryley, 1913 is known only from the Gersoppa Falls, Kanara, Mysore (Brosset 1962: 716). Another, *Myotis hasseltii* (Temminck 1840) has been recorded from four localities in Sri Lanka (Wroughton 1915: 86, Thomas 1915: 611, Phillips 1935: 125, 126). The third, *Myotis peshwa* (Thomas 1915) is apparently recorded in the literature only from two locations, one the type locality at Poona and the other Elephanta Island, off Bombay (Brosset 1962: 717).

[1] Accepted October 1975.

A small collection of bats received recently at the British Museum (Natural History) from Dr. S. V. Tirodkar, of the Science College, Satara, Maharashtra State includes four further specimens of *Myotis peshwa*, obtained in the neighbourhood of Satara, while the collections in London also include additional examples collected many years ago that have not been reported hitherto. These all agree closely with the holotype and with one other specimen from Poona, largely confirming the detailed description by Thomas. In one respect, however, the original description is misleading. Thomas says "Middle upper premolar about two thirds the size in cross-section of the anterior one, slightly drawn inwards, but not completely invisible from the outside. Below, the corresponding tooth is three fourths

the size of p^1, and stands quite in the toothrow." In the small series now available (including the holotype and the second specimen from Poona also examined by Thomas) the second or middle upper premolar (pm^3) is in fact about one third or very slightly more the cross-sectional area of the anterior tooth (pm^2). Usually in the toothrow or only slightly intruded from it, the tooth is occasionally more intruded but nevertheless remains clearly visible laterally, with pm^2 and the posterior upper premolar (pm^4) not in contact. The second or middle lower premolar (pm_3) is about the same size or even slightly larger than the anterior upper premolar (p^1 of Thomas): it is one half or a little less than one half the area of the anterior lower premolar (pm_2), and stands either in the toothrow or is slightly intruded from it, but not to the extent that pm_2 and the posterior lower premolar (pm_4) touch.

The species has been obtained from Sabalgarh, Gwalior, Madhya Pradesh, 26° 15′ N, 77° 24′ E; Elephanta Island, off Bombay, 18° 58′ N, 72° 57′ E; Poona, Maharashtra, 18° 34′ N, 73° 58′ E; near Satara, Maharashtra, *c.* 17° 43′ N, 74° 05′ E; and Kodai, Kumrun, Mangalore, Mysore, *c.* 12° 54′ N, 74° 51′ E. Specimens from all but Elephanta Island are in the collections of the British Museum (Natural History). Brosset (1962: 717) remarked of the specimen from Elephanta Island that it was roosting in a hole in the ceiling of a room with another individual, which escaped. Two of the specimens from Satara were collected from cracks in the stony ceiling of an abandoned tunnel in the forests of the Western Ghats, about two feet above the water level in the tunnel; the other two came from holes in the ceiling of a similarly abandoned tunnel. Each hole, made when the tunnel was constructed, held a pair of the bats. The first of these tunnels was shared with *Miniopterus schreibersii,* the second with *Hipposideros speoris.*

Myotis peshwa may be distinguished from *M. montivagus peytoni* by its smaller size (length of forearm in *peshwa* 36·3–40·1 mm, in *peytoni* 43·5–48·0 mm) and relatively larger foot which in length considerably exceeds one half of the length of the tibia. Although very similar externally to *M. hasseltii* it differs from this species in its narrower rostrum and braincase. Moreover, in *hasseltii* the second upper premolar (pm^3) is minute, usually about one quarter the area of the first upper premolar (pm^2) and as a rule is intruded from the toothrow to the extent that pm^2 and the posterior upper premolar (pm^4) are in contact or nearly so. The second lower premolar (pm_2) in *hasseltii* is correspondingly very small, sometimes minute, usually intruded from the row, on occasion almost completely so.

Ellerman & Morrison-Scott (1951: 149) list *peshwa* as a provisional subspecies of *Myotis adversus* (Horsfield 1824), a species which in their view, based on Tate (1941: 551), perhaps extends from Australia westwards to India. However, there is evidence (Hill 1972: 32; Hill & Thonglongya 1972: 188) to suggest that continental *Myotis* formerly referred to *adversus* should be allocated to *Myotis hasseltii* (Temminck 1840), *adversus* not extending westwards beyond Java and Borneo, where it appears to be sympatric with the easternmost of *hasseltii.* Ellerman & Morrison-Scott (1951: 149) refer *hasseltii* from Sri Lanka to "*Myotis* (?) *adversus* (?) subsp." since they say that the form quoted by Wroughton (1918) as *hasseltii* from Sri Lanka, forearm 40 mm in the key [in Wroughton 1918: 598] cannot be *hasseltii,* as Tate shows this to be a small form, with forearm 32 mm. Tate (1941: 557) quotes Temminck

TABLE

MEASUREMENTS (IN MM) OF *Myotis peshwa, M. dryas, M. horsfieldii, M. hasseltii* AND *M. adversus*

	M. peshwa			*M. dryas*	*M. horsfieldii*			*M. hasseltii*			*M. adversus*		
	N	R	M		N	R	M	N	R	M	N	R	M
Length of forearm	8	36.3-40.1	38.5	37.4*, 35.3	28	36.1-40.0	37.5	23	35.7-41.2	38.6	27	39.8-44.0	42.7
Greatest length of skull	8	15.4-16.1	15.7	15.2	25	14.6-16.0	15.4	18	15.1-16.6	15.9	8	16.3-17.4	16.9
Condylobasal length	8	14.3-14.7	14.6	14.1	25	13.2-14.7	14·0	17	13.9-15.5	14.5	8	14.9-15.8	15.4
Condylocanine length	8	13.6-14.1	13.9	13.5	25	13.0-13.9	13.4	17	13.1-14.7	13.8	8	14.0-14.9	14·6
Width across anteorbital foramina	8	3.9- 4.2	4.0	4.1	24	3.6- 4.2	3.9	17	4.2- 4.7	4.4	8	4.5- 4.7	4.5
Zygomatic width	3	9.7- 9.8	9.8	9.4	6	9.0- 9.5	9.4	6	9.8-10.3	10.1	4	10.4-10.5	10.4
Postorbital width	8	3.5- 3.9	3.7	3.7	25	3.2- 3.7	3.5	20	3.2- 4.2	4.0	8	4.0- 4.3	4.1
Width of braincase	8	7.3- 7.5	7.4	7.2	25	6.9- 7.4	7.1	19	7.6- 8.6	7.9	8	7.8- 8.0	7.9
Mastoid width	8	7.9- 8.2	8.0	7.8	24	7.5- 8.0	7.7	17	8.0- 8.7	8.4	8	8.5- 8.7	8.6
$c^1 - c^1$	8	4.0- 4.3	4.2	4.2	24	3.9- 4.3	4.1	18	4.1- 4.6	4.4	8	4.5- 4.8	4.7
$m^3 - m^3$	8	5.8- 6.1	6.0	5.9	25	5.6- 6.1	5.9	20	5.8- 6.7	6.3	8	6.4- 7.0	6.8
$c - m^3$	8	5.5- 5.8	5.7	5.7, 5.6	25	5.4- 6.0	5.7	20	5.4- 6.1	5.7	8	5 9- 6.4	6.2
Length complete mandible	8	10.6-11.0	10.8	10.7	19	10.4-11.0	10.7	11	10.3-11.6	11.1	7	11.3-11.9	11.7
Length right ramus	8	11.1-11.5	11,3	11.1	24	10.8-11.4	11,1	18	10.5-12.0	11.3	8	11.6-12.5	12.1
$c - m_3$	8	6.1- 6.3	6.2	6.0	25	6.0- 6.4	6.2	18	5.9- 6.5	6.2	8	6.3- 6.9	6.7

N = Number of specimens R = Range M = Mean * "Cotype" B.M. 6.12.1.31

(1840: 226), who says "Antebrachium 1 pouce 3 lignes" which Tate renders as 32 mm. These, however, are French inches and lines and the correct value is 34 mm as Tate found when he measured the "co-type", a young adult female. In fact, the specimens from Sri Lanka in London (a part of the sample identified by Wroughton) agree closely with *hasseltii* from Java and Malaya, as do the remainder of those examined by Wroughton, now in the collections of the Bombay Natural History Society. Brosset (1962: 715) compared *peshwa* with these in Bombay and noted their differences: he remarked (p. 715, footnote) that these specimens were called *hasseltii* but considered them representative of *adversus* with which *hasseltii* was then thought to be conspecific. As a result of his comparison he removed *peshwa* from any association with "*adversus*", i.e. from *hasseltii*.

Thomas, in the original description, regarded *peshwa* as the Indian representative of the Malayan and Javan species *M. horsfieldii*, to which he thought *peshwa* to be closely allied. There is much to commend this view, which Brosset (1962: 715) considered should be reviewed. In *horsfieldii* the wing originates from the metatarsus as in *peshwa*, the rostrum and braincase are similarly narrow, and there is a similar degree of dental reduction, the second upper premolar (pm^3) about one-quarter to one-third of the area of the anterior upper premolar (pm^2), sometimes only slightly intruded but more usually fully intruded from the toothrow and with the second lower premolar (pm_3) one third or a little more the area of the anterior lower premolar (pm_2), usually slightly intruded but occasionally more fully pushed in from the toothrow. As Thomas points out, *peshwa* is slightly larger and browner than *horsfieldii*, but the number of specimens of *peshwa* in dry preservation is limited for colour comparison.

Myotis dryas Andersen 1907 from South Andaman Island is also considered by Ellerman & Morrison-Scott (1951: 149) and by Hill (1967: 7) to be possibly a subspecies of *M. adversus*. However, this bat, represented in London only by the holotype and by a second specimen labelled "Andamans" which has no more than the rostrum and the anterior part of the mandible remaining, seems also much nearer to *horsfieldii* than to *adversus* or more especially to *hasseltii*. The insertion of the wing is at the ankle or on the metatarsus, the rostrum and braincase are narrow, and the anterior and second premolars (pm 2/2-3/3) are of similar proportions to those of *peshwa* and *horsfieldii*, pm^3 slightly intruded from the toothrow, pm_3 standing in the row. Andersen (1907: 37), who had solely the holotype of *adversus* for comparison (its skull is represented by no more than the rostrum and mandible) and lacked both *hasseltii* and *horsfieldii*, noted that the rostrum of *dryas* is lower, both anteriorly and posteriorly than that of *adversus*, and that the bony palate is narrower. While the small number of specimens at present available precludes any comprehensive revision of this group of large-footed *Myotis*, there is good evidence nevertheless to suggest that *peshwa* and *dryas* are best considered more closely related to *M. horsfieldii* than to *M. hasseltii* or to *M. adversus*.

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Pteris quadriaurita Retz. and a few related taxa in Kerala State[1]

N. C. Nair[2] and S. R. Ghosh[3]

Pteris quadriaurita Retz. is considered to be a Sri Lanka and South Indian species. Reports of this taxon from other parts of Indian subcontinent need confirmation. Additional information about *P. multiaurita* Agardh is provided. These two taxa hybridize freely in nature. *P. confusa* Walker, *P. gongalensis* Walker and *P. praetermissa* Walker are recorded for the first time from India.

Pteris quadriaurita Retz. and related taxa represent one of the most confusing assemblage of ferns whose taxonomic separation is extremely difficult and consequently several species have been passed off in the past as *P. quadriaurita* Retz. On a study of this bewildering group in Kerala we have come across some interesting findings which are recorded below. The specimens mentioned are deposited in the herbarium of the Cryptogamic Unit of the Botanical Survey of India, Sibpur, Howrah.

1. *Pteris quadriaurita* Retz. was named and described in 1791 by Retzius based on a specimen from Sri Lanka collected by King. The circumscription of the species varied according to different authors. Hooker (1858) and Hooker & Baker (1868) used the name in a very wide sense and considered *P. nemoralis* Hook. et Baker, *P. biaurita* var. Sw., and *P. calcarata* Bory as synonyms. A more or less similar view was held by Agardh (1839). Clarke (1880) has included *P. aspericaulis* Wall. ex Agardh, *P. pectinata* Don, *P. pyrophylla* Blume, *P. spinescence* Presl, and *P. subquinata* Wall. ex Agardh as synonyms of *P. quadriaurita* Retz. in addition to *P. nemoralis* Hook. et Baker. He also distinguished three varieties namely, *major, khasiana* and *blumeana*. Beddome (1883, 1892) recognised Clarke's varieties and added another variety *setigera*. *P. subindivisa* Clarke, *P. subquinata* Wall. ex Agardh and *P. aspericaulis* Wall. ex Agardh are also treated as varieties. Beddome (1863) gave two figures, one for *P. otaria* and another for *P. otaria* var. The latter bears a mark of interrogation. A few years later he (1883) considered *P. otaria* Bedd. as the same as *P. quadriaurita* var. *ludens* Bedd.

Hieronymus (1914) showed that the name *P. quadriaurita* Retz. was misapplied to several taxa, gave a new description to it, and recognised (1911, 1914) several new species in the original circumscription of the species. Blatter & Almeida (1922) expanded the description to embrace three species, *P. quadriaurita* Retz., *P. biaurita* Linn., and *P. nemoralis* Willd. thereby creating more confusion in the study of this group of Indian ferns.

Beddome (1892) gave the distribution of

[1] Accepted January 1974.

[2] Botanical Survey of India, R.S. Puram, Coimbatore 641 002.

[3] Botanical Survey of India, Sibpur, Howrah 711 103.

P. quadriaurita Retz. as follows, "Throughout India, Sri Lanka and Malay Peninsula, from the plains up to 8000 feet, very common. (Also all round the world throughout the tropics and a little beyond them)". In giving this distribution he faithfully followed Hooker (1858), and Hooker & Baker (1868). This seem to be the reason for the supposition by Indian authors that the taxon exists throughout India. An examination of the material in the Cryptogamic Unit of the Botanical Survey of India, Sibpur, confirmed the view of Walker (1958) that the true *P. quadriaurita* Retz. does not occur outside Sri Lanka and South India. Therefore the reported occurrence of *P. quadriaurita* Retz. from Assam (Kachroo 1953), Darjeeling (Mehra & Bir 1964), Eastern India (Panigrahi 1960), Eastern Himalayas (Hara 1966), Kashmir (Stewart 1945), Madhya Pradesh (Tiwari 1964), Mussoorie (Mehra 1939), Nainital (Loyal 1960), North-Western India (Hope 1901), Orissa (Mooney 1950); Panigrahi *et al.* (1964) and Simla (Bir 1963) etc. needs confirmation.

Pteris quadriaurita Retz. Obs. 6:38, 1791; Willd. Sp. Pl. 385, 1810; Agardh, Gen. Pter. 24, 1839; Bedd. Handb. Ferns Brit. Ind. 110, 1883 (pro parte); Hieron. in Hedwig. 55:1914; Walker in Evolution 12: fig. 4 top right, 1958; Kew Bull. 14:324; fig. 1, 1a, t. 5, fig. c, I, 1960.

Rhizome erect. Fronds variable in size. Stipe tufted, stramineous 40-45 cm long, grooved, glabrous. Lamina 30-35 cm or more semi-coreaceous. Rachis grooved, stramineous. Pinnae 4-10 subopposite pairs, the lowest bipartite, narrowly oblong, acuminate and cut down into several oblong segments 1.5×0.8 cm, apex rounded, serrated, sinus nearly reaching the costa. Veins usually once-forked, free, 6-10 pairs, lowest vein reaching the margin above sinus, long spinules present on the costa and costule. Sorus not reaching the sinus and apex of the segments. Indusia membranous, white. Spores light brown or honey coloured, about 30 μ in diameter, tuberculate.

In Kerala this fern appears to be not very common. It is seen in small populations on the margin of forests where the ground vegetation is sparse. Wherever human interference is common this species is either very rare or absent.

Diploid and sexual material have chromsome numbers n = 29, 2n = 58 (Abraham *et al.* 1962; Manton & Sledge 1954; Walker 1960).

Material examined—Vennikulum, *N. C. Nair* 50824 (Dec. 16, 1972): Vennikulum—Thiruvella, *N. C. Nair* 50832 (Dec. 16, 1972).

Plants having general similarity and affinity with *P. quadriaurita* Retz. but with extremely varying degrees of abortive pinnules are abundant and widely distributed along road-sides, riverbanks, paths through forests, as undergrowth in forests, in well lighted places, and in forests where human interference is common. Thwaites (1864) and Walker (1958, 1960) state that an array of such forms are abundant in Sri Lanka. Some of the Kerala forms have serrate apex for ultimate pinnules. Others lack this character. Some have spinules on ultimate pinnules; others have none. All gradations from wiry to rigidly erect habit can be met with. Similar wide range of variation is very common. These forms were named as *P. otaria* by Beddome (1863) and later (1883, 1892), *P. quadriaurita* var. *ludens* Bedd. Thwaites (1864) suggested that some of the forms were of hybrid origin. He was also of the opinion that another pinnate species *P. ensiformis* Burm. might also be involved here. But *P. ensiformis* Burm. is a tetraploid with n = 58 (Abraham *et al.* 1962), 2n = 116 (Walker 1958). Further, when Walker (1958) crossed it with *P. otaria* Bedd. triploid

hybrids were formed showing complete failure of chromosome pairing. Giesenhagen (1918) concluded that *P. otaria* Bedd. is nothing but developmental stages. He attributed the abortion of the pinnules to lack of availability of nutrients to the juvenile fronds. After making a comprehensive study of cytotaxonomy and hybridization, Walker (1958) has clearly shown that *P. otaria* Bedd. is nothing but a hybrid between *P. quadriaurita* Retz. and *P. multiaurita* Agardh. Where the natural habitat of these two taxa have been disturbed by man these species frequently hybridize and an imposing array of hybrid swarms exhibiting an intricate seggregation marked by differently and irregularly pinnatifid pinnae are formed (*see* Walker 1958). In spite of the fertile hybrid nature of *P. otaria* Bedd., Abraham *et al.* (1962) treat it as a distinct taxon. In Kerala *P. quadriaurita* Retz. × *P. multiaurita* Agardh. hybrid swarms are more common than the parents. This speaks for the large scale human interference in the ecological preferences of the parent species.

Specimens examined.—Aryankavu, *N. C. Nair* 50673, 50674, 50690, 50694, 50697, (Dec. 24, 1972); Kulathupuzha, *N. C. Nai*r 50656, 50663, (Dec. 23, 1972); Punalur, *N. C. Nair* 50884, 50886 (Dec. 26, 1972); Ranni, *N. C. Nair* 50589 (Dec. 18, 1972); Vennikulum, *N. C. Nair* 50827, 50829, 50834, 50846, 50847 (Dec. 16, 1972).

2. *Pteris multiaurita* Agardh was considered as a synonym of *P. cretica* Linn. by Beddome (1863). In his Handbook (1883) and Supplement (1892) no mention is made of *P. multiaurita* Agardh. Christensen (1906) also considered *P. multiaurita* Agardh as the same as *P. cretica* Linn. *Pteris cretica* Linn. and *P. multiaurita* Agardh are clearly distinct species, differing in several characters. The confusion seems to be due to the simply pinnate nature of the two taxa. They can be easily distinguished by the following key:

Pinnae on each side 11-13; lateral veins of pinnae usually twice forked; spinules present on the sterile pinnae; rhizome creeping .... *P. multiaurita*
Pinnae on each side 4-6; lateral veins of pinnae usually once-forked; spinules absent in the sterile pinnae; rhizome not creeping, erect .... *P. cretica*

Walker (1958, 1960) thinks that *P. multiaurita* Agardh is allied to *P. quadriaurita* Retz., since they hybridize freely producing fertile hybrids (see above).

Agardh (1839) states that *P. multiaurita* Agardh is a Sri Lanka species. He also adds that he has seen a sheet in Paris Museum collected from Nilgiri mountains by Leschenault. It is significant that no subsequent author has recorded this species from India. We have made several gatherings of this taxon from Kerala.

Pteris multiaurita Agardh, Rec. Sp. Gen. Pteridis 12, 1839; Walker in Kew Bull. 14:323, 1960.

Rhizome creeping. Fronds dimorphous, simply pinnate, semi-coriaceous or herbaceous. Stipe of sterile frond 12-25 cm long glabrous, wiry, stramineous, grooved, scaly and black at the base. Pinnae 8-10 cm × 0.6-0.8 cm petiolate; petiole 0.2 mm, most pinnae except apical ones bipartite, apex acuminate, margin entire except a few denticulations towards the tip; veins free, mostly twice forked. Long spinules present on the costa of the sterile pinnae. Fertile frond much larger than the sterile frond. Stipe 35-44 cm long, grooved. Pinnae 10-13 × 0.8 cm. Veins twice forked. Spinules mostly absent. Indusium hyaline. Spores light brown to dark brown.

As mentioned above this species freely hybridizes in nature with *P. quadriaurita* Retz. and according to Walker (1958) these two species are separated in nature by ecological barriers only. This species has a preference

for lightly shaded areas such as the edge of forests, road sides etc.

Specimens examined.—Kulathupuzha, *N. C. Nair* 50657 (Dec. 23, 1972); Pathanamthitta, *N. C. Nair* 50586 (Dec. 18, 1972), 50859 (Dec. 12, 1972); Ranni, *N. C. Nair* 50590 (Dec. 18, 1972); Thiruvella, *N. C. Nair* 50840 (Dec. 16, 1972).

3. Walker (1960) described a new species *P. gongalensis* from Sri Lanka. This species is distinguished from other members of the *P. quadriaurita* Complex by (1) the deltoid frond, (2) the spinules throughout inconspicuous, (3) the very regular appearance of pinnae, (4) non serrated apex of the ultimate segments, (5) large dark brown spores intermixed with mishappen spores, and (6) the sculpturing and size of the spores.

According to Walker (1960) this species is endemic to Sri Lanka. But one of us has collected it from several localities in Kerala. This discovery is not surprising since Kerala is not far removed from Sri Lanka and the climatic conditions are almost identical.

Pteris gongalensis T. G. Walker in Kew Bull. 14:328, fig. 4, 4a, t. 5, fig. A, G., 1960.

Rhizome short erect. Stipes 20-60 cm, stramineous grooved. Lamina deltoid, up to 50 cm long, 16-32 cm broad, lateral pinnae 5-8 pairs, herbaceous 2 cm long, lanceolate, lowest bipartite, terminal pinnae of the same size and shape, pinnae regularly pinnatifid, sinus about 1 mm from the costa; segments oblong 1.2-2.2 × 0.4-0.6 cm, apex rounded not serrated; veins free, 9-14 pairs; spinules present on the costa and costules, inconspicuous. Indusium very narrow, papery, white. Sori continuous except base and apex of segments. Spores tetrahedral globose.

Not a common fern in Kerala.

Chromosome number in the gametophyte and the sporophyte of Sri Lanka material is 87 (Walker 1960).

Specimens examined.—Nadukani (near Idiki alt. 800 m), *N. C. Nair* 40727 (Dec. 27, 1970), on moist slopes in shade; Thankamani (800 m), *N. C. Nair* 40755 (Dec. 28, 1970), near stream along footpaths and on steep slopes in shade; Vennikulum, *N. C. Nair* 50845 (Dec. 16, 1972).

4. A second new species having close affinity with *P. quadriaurita* Retz. described by Walker (1960) is *P. confusa* Walker which can be distinguished by the stramineous stipe, sinus not nearly reaching the costa, the presence of well-filled spores intermixed with mishappen abortive ones, and the conspicuous spore markings. According to Walker (1960) this is an apogamous diploid with 59 chromosomes. This species has certain features of similarity with *P. biaurita* Linn. These two species can be easily separated by its venation, *P. biaurita* Linn. has basal veins which anastomose and form a costal arch whereas *P. confusa* has free veins. This is the first report of the taxon from India.

Pteris confusa T. G. Walker (in Evolution 12: 88, fig. 4, tip middle, nomen et fig.) in Kew Bull. 14:329, fig. 5, 5a, t. 5, fig. B, J, 1960.

Rhizome short erect. Stipe 30-70 cm, stramineous, base chestnut brown. Lamina green, ovate 56 cm long, lateral pinnae 4-9 pairs; 12-27 cm long about 3 cm broad, lowest bipartite, regularly pinnatifid; segments oblong 1.5 × 0.4 cm, about 26 pairs, apex entire; veins free 12-14 pairs; sinus nearly 2 mm from costa, spinules absent or very few at the crossing of costa and costule. Indusia thin, papery. Spores tetrahedro-globose.

This appears to be a rare fern in Kerala.

Specimens examined.—Kumuli (alt. 750 m), *N. C. Nair* 40463 (Oct. 16, 1968); Neriamangalam, *N. C. Nair* 50711 (Jan. 7, 1973); Thankamani (alt. 800 m), *N. C. Nair* 40417 (Dec.

1970).

5. A third species described by Walker (1960) namely, *P. praetermissa* Walker was considered to be endemic to Sri Lanka. This is recorded here for the first time from India. This taxon can be distinguished from other allied species by the characters such as the presence of long, conspicuous spinules on the costa, the usually dark colour of the rachis and stipe, the long spinules on the segments, the sinus extending almost to the costa and the characteristic spore.

Sri Lanka plants are sexual diploids having chromosome number x = 29 and 2x = 58 (Walker 1960).

Pteris praetermissa T. G. Walker in Kew Bull. 14:327, fig. 3, 3a, t. 5, fig. F. 1960.

Rhizome short, erect stipes tufted 20-50 cm long, purpureus, base blackish, glabrous. Rhachis stramineous glossy. Lamina ovate 17-40 cm, lateral pinnae 4-8 pairs oblong, acuminate, 13-15 × 3 cm, regularly pinnatifid, segments 14-25 pairs, apex rounded not serrated, veins free 9-12 pairs, long spinules are present on costa and costule. Sinus not greater than 1-33 mm from the costa. Indusia white, continuous; sorus not reaching the sinus and apex of the segments.

This is a very common species in Kerala growing along road sides, near streams and in jungles both open and closed.

Sri Lanka plants are sexual diploids according to Walker (1960) and have chromosome numbers x = 29 and 2x = 58.

Specimens examined.—Chadayamangalam *N. C. Nair* 50929 (Dec. 31, 1972); Kaviyur, *N. C. Nair* 50808 (Dec. 15, 1972); Kottarakara, *N. C. Nair* 50921 (Dec. 30, 1972); Kulathupuzha, *N. C. Nair* 50642 (Dec. 22, 1972), 50644 (Dec. 22, 1972), 50667 (Dec. 23, 1972); Kunnumthanam, *N. C. Nair* 50812 (Dec. 15, 1972), 50821 (Dec. 15, 1972), Pathanamthitta, *N. C. Nair* 50593 (Dec. 12, 1972); Perunna (alt. 30 m), *N. C. Nair* 40268A, 40268B (Dec. 12, 1970); Punalur, *N. C. Nair* 50878 (Dec. 26, 1972), 50881 (Dec. 26, 1972), 50909 (Dec. 28, 1972), 50913 (Dec. 28, 1972); Thiruvella, *N. C. Nair* 50805 (Dec. 15, 1972); Vennikulum, *N. C. Nair* 50835 (Dec. 16, 1972).

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A study of the associative behaviour of the fish *Amphiprion polymnus* (Linn.) and Sea Anemone *Stoichactis giganteum* (Forsk.)[1]

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Though sea anemones are known to prey upon fishes of many species by means of the venomous nematocysts covering their tentacles (Gudger 1941; Mariscal 1966a), several species of *Amphiprion* live in intimate association with the anemones throughout life. A summary of reported associations of *Amphiprion* with sea anemones has been given by Mariscal (1972). Day (1878) reported the fish *Amphiprion percula* in association with the sea anemone *Actinia* sp. at Andaman Islands. Mahadevan & Nayar (1965) were the first to describe an association of *Amphiprion sebae* with the giant sea anemone *Stoichactis giganteum* off Tuticorin on the south Indian coast. Recently, *Amphiprion polymnus* (Linn.) has been recorded from the Indian coasts (Trivedi 1974). The purpose of this paper is to present the results of a field and laboratory study of the associative behaviour of *Amphiprion polymnus* and the giant sea anemone *Stoichactis giganteum*.

FIELD OBSERVATIONS

Field observations were made at Mithapur coast (69° 01′ E., 22° 25′ N.) of Gujarat. The sea anemone, *Stoichactis giganteum*, was found in depressions and crevices in littoral zone of the limestone reef among stands of living coral and seaweeds.

Its pedal disc is fastened strongly to the rocky substratum and the well-expanded oral disc is immediately retracted on disturbance. *S. giganteum* merged nicely with its surroundings of green-and-red algae and corals, and could be distinguished only on close observation.

Often one or two *A. polymnus*, of unequal size when found in a pair ,were found swimming over and about the anemone. On approach the fishes quickly entered the mouth of the anemone. The anemone, if disturbed further, immediately retracted enclosing the fishes between its tentacles. Despite the disturbance the fish, however, did not move away from its host, although the anemone was in retracted condition for a period ranging 10-15 minutes. This type of behaviour has been observed in *A. percula*, *A. akallopisos* and *A. perideraion* (Eibl-Eibesfeldt 1960; Mariscal 1966a, b, 1970b).

In one case the author attempted to transfer an *A. polymnus* from its original host to another individual of the same species and size; the new host was then not harbouring any symbiotic fish. In the changed condition

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also the fish showed the normal behaviour as with the former host. This supports the finding of Mariscal (1972) that there was no chemical recognition or preference by an *Amphiprion* for an anemone with which it had been living for an extended period and that any preference between two anemones of the same size, shape, colour, and species seemed to be correlated with the relative expansion of the oral disc at the time of the experiment.

Some *S. giganteum* without any symbiotic *Amphiprion* were found harbouring a pair each of symbiotic shrimps of *Periclimenes* sp. The shrimps were of unequal size and consisted generally of one male and one female (bigger than male). The presence of a berried female afforded a clue to sexual dimorphism of the shrimps present.

Laboratory Studies

Laboratory studies were conducted at Okha in a 90 cm × 45 cm × 45 cm glass aquarium with sea water, with necessary aeration facilities, using *A. polymnus* fishes collected from Mithapur and *S. giganteum* anemone from Okha coast.

In order to note behavioural pattern in the experiments the fish was introduced first. Soon after introduction the fish went straight to one corner of the aquarium and started " rocking movement " in a rhythmic manner. This movement, also described as " up and down swimming ", " bobbing ", " bouncing " and " seesawing " behaviour, consisted of rapid elevation and depression of anterior portion of the body at a fixed place. This type of behaviour is found to be more pronounced among isolated fishes, although it occurs in the fishes kept with anemones (Eibl-Eibesfeldt 1960; Mariscal 1970b). This behaviour can possibly be ascribed as an attempt to gauge the distance between shelter and approaching object, in order to facilitate easy and quick retreat.

A. polymnus also bathed in the air bubbles produced by the air diffuser stone, in the same manner as described by Mariscal (1966b, 1970b) in the case of *A. xanthurus*.

No territorial defence or agonistic behaviour was exhibited by *A. polymnus* during isolation. On introducing a pair of shrimps of *Periclimenes* sp., the *Amphiprion* quickly swam towards them, observed them cautiously and returned to its corner apparently without paying much attention.

After two days a *Stoichactis giganteum* from Okha coast was introduced into the aquarium. Mariscal (1972), commenting on the findings of Fishelson (1965), has remarked that *A. bicinctus* specimens already living with anemones would not be expected to undergo acclimation again with new anemones of the same species. Although *A. polymnus* were living with *S. giganteum* in this case, they had to undergo the acclimation with a new anemone of the same species.

For about an hour *A. polymnus* did not seem to come in contact with the anemone and remained in a corner. After that, the fishes were forcibly driven towards the anemone and they started the acclimation process, perhaps after recognition of the host. Visual stimuli are thought to be primary in the recognition of anemones by anemone fishes (Verwey 1930; Herre 1936; Gohar 1948; Davenport & Norris 1958; Mariscal 1966b, 1970b). At the start of acclimation behaviour, the fish hovered above the anemone in its typical 'up-and-down-swimming' without touching it. Then it suddenly, but cautiously, nibbled a clump of tentacles of the anemone from the side and went up. After hovering for some time it made a brief contact of the tentacles with its pelvic and

anal fins, causing a strong clinging of tentacles to the fish followed by a violent jerking back by the fish and subsequent contraction of the tentacle in typical prey-capture response. The fish repeated the process many times, gradually increasing the degree of contact and penetration of the anemone's tentacles. As a result the clinging reaction of the anemone's tentacles diminished, indicating that the fish was becoming partially protected from the anemone's nematocysts. Finally the fish began " bathing " among the tentacles, with little or no response on the part of the anemone, indicating acclimation was complete, and the guest accepted.

The time of acclimation varies with different species of anemones. In this case it took only about 15 minutes. *A. xanthurus* got acclimated to the tropical anemone *Stoichactis kenti* in about 10 minutes, to the California anemone *Anthopleura xanthogrammica* in about 1 hour, and to *Anthopleura elegantissima* (California) in about 45 hours in one instance (Mariscal 1970a).

Now the question arises as to the type of change that occurs — in fish or in anemone — which gives protection from the nematocysts to the fish. Experiments by Davenport & Norris (1958) and Mariscal (1966b, 1970a, 1971) demonstrated that it is the mucus coating of an acclimated *Amphiprion* which is responsible for the protection. They found out that, if this mucus is carefully removed, the acclimated or partially acclimated fish immediately becomes deacclimated and is stung upon every contact with the tentacles of its former anemone, though this has not been confirmed by this author.

The territorial behaviour of *Amphiprion* has been well known (as listed by Mariscal 1972). *A. polymnus* also showed this type of behaviour. It did not allow the shrimp, *Periclimenes* sp. to come near anemone. On keeping the *Periclimenes* directly between the tentacles of the anemone occupied by *A. polymnus*, the fish attacked the shrimp aggressively, chasing and driving it away from the anemone.

A. polymnus like other *Amphiprion* was also found to be an omnivorous feeder. It accepted any kind of plankton or other organic material. However, as also reported by Mariscal (1970b), once such material touched the bottom *A. polymnus* usually did not try to seize it.

A. polymnus, like other *Amphiprion* (see Mariscal 1972) also fed on waste material egested by the anemone. It was also found to nibble or tear off and ingest pieces of the tentacles of *S. giganteum*. This type of behaviour is also reported in other *Amphiprion* by Verwey (1930), Eibl-Eibesfeldt (1960) and Mariscal (1966b, 1970b). *A. polymnus* also took food to its anemone as described in other species of *Amphiprion* by many authors (Mariscal 1972).

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Notes on the birds of prey in the Indus valley[1]

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Introduction

In this paper I hope to give an impression of the present status of the birds of prey. Their existence is threatened in almost all parts of the world. The favourable conditions presently prevailing will certainly diminish, and we can only hope that a part of the richness of the Indus valley can be preserved.

Material

The observations have been made during five visits to Pakistan in the years 1970 to 1974. All visits took place in the months December, January and February. Only very few observations have been made in March. The aim of the expeditions was to carry out a winter survey of waterfowl on the lakes and wetlands of Pakistan on behalf of the International Waterfowl Research Bureau.

The work involved intensive travelling by car, during which we noted down all the raptors seen. Most lakes in the Punjab and in Sind are situated close to the river Indus. We did not survey Baluchistan, and have only very few observations from the NWFP.

Table 1 summarises all sightings of birds of prey. It should however be understood that such a list does not give an exact picture of the composition of the birds of prey population. This for the following reasons:

1. When observing from a moving car one certainly overlooks the smaller birds of prey very easily.
2. Species having the habit of perching prominently on telephone poles etc. will be represented in higher numbers than those species which do not have this habit.
3. Our surveys only covered the valley of the river Indus.

The total number of species observed was 34. It is remarkable that the Falconidae only play a very unimportant role in the total population. Of some species we were able to form an impression about the densities by taking the average number seen per stretch of 10 miles. Often those densities far exceeded our experience in the surrounding countries like Iran, Afghanistan, Iraq, Turkey or Gujarat in India.

Conservation

In the province of Sind all birds of prey are protected by law and we hope that the other provinces will follow this example.

Hardly any statistical material has been collected so far. It is however certain that many species, especially the falcons, have diminished considerably during the last years.

The reasons for the decline are deforesta-

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tion, drainage of marshes, land use and the use of pesticides. All those developments are related with the social circumstances and it will be very difficult to take measures to stop the decline.

Very rare and specialized species like the Pallas's Fishing Eagle certainly need protective measures. Big trees in the surroundings of lakes are becoming scarce and the eagles need such trees for nesting. It would be interesting to build artificially made nests and place them near suitable lakes. For storks and birds of prey such nests have been successful in Europe.

TABLE 1

SIGHTINGS OF BIRDS OF PREY DURING FIVE WINTER VISITS TO THE INDUS VALLEY 1970-1974

Blackwinged kite	*Elanus caeruleus*	181
Honey Buzzard	*Pernis ptilorhyncus*	10
Black kite	*Milvus migrans*	4,599
Brahminy Kite	*Haliastur indus*	80
Shikra	*Accipiter badius*	38
Longlegged Buzzard	*Buteo rufinus*	220
Buzzard	*Buteo buteo*	2
White-eyed buzzard	*Butastur teesa*	262
Bonelli's Hawk-Eagle	*Nisaetus fasciatus*	262
Booted Eagle	*Hieraaetus pennatus*	8
Golden Eagle	*Aquila chrysaetos*	1
Imperial Eagle	*Aquila heliaca*	56
Tawny Eagle	*Aquila rapax*	386
Tawny? or Imperial Eagle?	*Aquila ??*	223
Greater Spotted Eagle	*Aquila clanga*	204
Pallas's Fishing Eagle	*Haliaeetus leucoryphus*	77
Whitetailed Eagle	*Haliaeetus albicilla*	12
Cinereous Vulture	*Aegypius monachus*	20
Griffon Vulture	*Gyps fulvus*	140
Whitebacked Vulture	*Gyps bengalensis*	1,725
Egyptian Vulture	*Neophron percnopterus*	229
Lämmergeier	*Gypaetus barbatus*	18
Hen Harrier	*Circus cyaneus*	14
Pale Harrier	*Circus macrourus*	57
Montagu's Harrier	*Circus pygargus*	3
Marsh Harrier	*Circus aeruginosus*	509
Short-toed Eagle	*Circaetus gallicus*	18
Osprey	*Pandion haliaetus*	155
Lanner Falcon	*Falco biarmicus*	14
Peregrine Falcon	*Falco peregrinus*	6
Merlin	*Falco columbarius*	1
Indian merlin	*Falco chicquera*	15
Kestrel	*Falco tinnunculus*	69
Saker Falcon	*Falco cherrug*	1

BLACKWINGED KITE *Elanus caeruleus*

The Blackwinged kite can be seen in most parts of the Indus valley. The best habitats in which we observed this magnificent bird were cultivated lands with scattered trees and an abundance of shallow waters, marshes or rice fields. The population is resident but considerable differences in population density occur.

In the habitat mentioned we observed averages ranging from 0.5 to 2.8 bird on a stretch of 10 miles.

In Lower Sind the Blackwinged kite is very common and in the regions of Mirpur Sakro, Badin and Ladiun we observed densities of 0.3 to 0.9 bird per 10 miles. Once near Khandkot we counted 15 birds in 31 miles which accounts for 4.8 bird per 10 miles.

In the Punjab, and certainly in NWFP, the blackwinged kite seemed less common to us.

CRESTED HONEY BUZZARD *Pernis ptilorhyncus*

The Honey Buzzard is a resident or at least a summer visitor to Pakistan. It frequents forests and this habitat is rather scarce. Most of our records are from the Punjab and from northern parts in Sind. Only one record from Lower Sind. We observed 10 birds only, but according to Mr. T. J. Roberts (pers. comm.) the Honey Buzzard breeds in good numbers in the Punjab up to the Murree hills.

BLACK KITE *Milvus migrans*

Three different subspecies of this kite can be found in Pakistan. We made no attempts to separate them. The Black kite is certainly the most common bird of prey in Pakistan. The cities have hundreds of kites and metropoles like Lahore or Karachi will have populations of several thousands of birds.

The kites concentrate on rubbish dumps, near fishing industries or in parks. It often was impossible to estimate their exact numbers. Some of our records show their abundance: 250 on a roost in Thatta on 9-i-1974; 319 between Thatta and the outskirts of Karachi and 550 on a rubbish dump near Karachi both on 17-xii-1972 and finally 320 kites along the shores of lake Rap near Ghauspur.

The kites breed in trees, on buildings, on telephone poles or on electricity pylons. In January and February we often found nests with eggs or young birds.

BRAHMINY KITE *Haliastur indus*

A magnificent raptor which can usually be seen on wetlands with strongly fluctuating water levels. It frequents barrages and treelined canals also.

It is common along the tidal creeks in the mouth of the Indus river. On a boat trip from Karachi to Ketti Bandar we observed 12 birds on 20-ii-1972. Our most northern observations are from the Taunsa Barrage. We have no observations from NWFP, the Saltrange or the Punjab N. of Multan.

The habitat of this species is rather restricted and this is probably the reason why it is not a common bird in Pakistan.

The food of this kite consists of dead fish, frogs, mud-skippers and lizards.

SHIKRA *Accipiter badius* and/or *A. nisus*

The Sparrow-Hawk lives in forests and in former days certainly has been more common than at present. During our waterfowl surveys we usually worked in open country with the result that we observed few Shikras. The records are all from the Punjab and from Sind; none from NWFP. In the Punjab the Sparrow-Hawk breeds along treelined canals, in forests and even in cantonment gardens.

LONGLEGGED BUZZARD *Buteo rufinus*

Common winter visitor to all parts of Pakistan. The Longlegged Buzzard can be seen in

all types of habitat ranging from deserts to cultivated areas. When we analyze our 220 observations we find that in Sind the population is 4 times as dense as that in the Punjab or NWFP.

In Sind their number averaged 0.8 bird in 10 miles; in the Punjab, the NWFP and near Quetta this figure was 0.2 bird on a stretch of 10 miles.

The species is extremely variable in coloration. In Pakistan the whitish and reddish phase dominate, while only one out of twenty birds shows a very dark brown plumage.

BUZZARD *Buteo buteo*

A rare bird in most parts of the Indus valley. The buzzard breeds in the Himalayas and probably does not migrate to the plains. It remains in the foothills during winter. We have two records only, both from the NWFP: one bird near lake Kheski on 29-i-1974 and one bird near Kohat only a few days later. Mr. T. J. Roberts (pers. comm.) has definite records from Lower Sind but agrees it is rare.

WHITE-EYED BUZZARD *Butastur teesa*

One of the commonest species, especially in the Punjab and in Sind. It lives in open country with small groups of trees or bushes. It is absent from the higher parts of Pakistan. We have only two observations from the NWFP, both from the month of March and none from January or February. Also in the Salt range the white-eyed Buzzard can be classified as rare.

In Sind we counted 73 birds in 784 miles which averages 0.9 bird per 10 miles. In the Punjab the population density seemed less. Here we observed 22 birds in 546 miles which averages 0.4 bird in 10 miles.

BONELLI'S HAWK-EAGLE *Nisaetus fasciatus*

A rather rare bird which can be found in small numbers on some of the lakes in Sind. It also occurs in hilly habitats (Kohistan, Salt Range and Margalla hills). We have 14 sightings only. The lakes where we observed this species often had a rich vegetation and an abundance of waterfowl (Phoosna, Sadori, Talli, Charwo, Langh and Haleji). Conservation of those rich freshwater lakes of Sind will certainly contribute to the survival of this rare eagle.

Bonelli's Eagles often catch duck or coot. However their prey is frequently pirated from them by less active birds of the genus *Aquila*.

BOOTED EAGLE *Hieraetus pennatus*

An easily overlooked resident species which breeds in Baluchistan and Hazara district.

Rare bird: eight observations only. Three birds were seen between Basal and Attock on 30-iii-1970. One near Bahawalpur on 15-ii-1972 and four records from Sind in the months January and December. It is perhaps a regular but rather rare winter visitor to Lower Sind.

GOLDEN EAGLE *Aquila chrysaetos*

The Golden Eagle is said to breed in the Himalayas and in the higher parts of Baluchistan. It seldom comes down to the valley of the river Indus. We have only one record: a juvenile on 14-i-1974 at 20 miles S. of Badin.

IMPERIAL EAGLE *Aquila heliaca*

Most authors are very vague about the status of the Imperial Eagle in Pakistan. The reason is that the different species of the genus *Aquila* are very difficult to identify. The Imperial Eagle can easily be mistaken for a Tawny Eagle. It however can easily be distinguished from the Spotted Eagle. Out of 442 big eagles 56 were Imperial Eagles. So we have the impression that at least 1 out of 8 big eagles can be an Imperial Eagle. The spe-

cies is a winter visitor and prefers open desert areas or lakes; in general it avoids extensive cultivations.

TAWNY EAGLE *Aquila rapax*

Common in all parts of Pakistan. We identified 386 individuals while most of the 223 unidentified eagles certainly also belonged to this species. It prefers all sorts of open country. In the Punjab and in many parts of Sind the densities are between 0.4 and 1.2 bird per stretch of 10 miles. In Lower Sind the Tawny Eagle is extremely abundant: 4.2 per stretch of 10 miles.

GREATER SPOTTED EAGLE *Aquila clanga*

Not uncommon. Almost all observations are correlated with the presence of water like lakes, canals or marshes. The total number seen was 204 birds. So the Greater Spotted Eagle is less abundant than the Tawny Eagle but certainly commoner than the Imperial Eagle. The species is a winter visitor mainly. We do not have records from lakes situated N. of the Taunsa Barrage.

WHITETAILED SEA EAGLE *Haliaeetus albicilla*

The rarest regular winter visitor to Pakistan. Total population less than five!

There are only three locations in Pakistan where we observed this very rare winter visitor. All these three are large wetlands which afford winter refuge to between 20,000 and 50,000 ducks and coots.

List of observations:

Chasma Barrage: 2 on 9-ii-1971 and 1 on 2-ii-1973.

Ghauspur: 2 on 15-ii-1971, 1 on 10-ii-1973 and 3 on 28-xii-1973.

Taunsa Barrage: 2 on 5-ii-1973 and 1 on 26-xii-1973.

PALLAS'S FISHING EAGLE *Haliaeetus leucoryphus*

The habitat of this rather rare bird is scarce and for this reason the birds are mainly seen in the southern parts of Pakistan.

We encountered Pallas's Fishing Eagle on 18 different lakes. The habitat should include freshwater with an abundance of fish, waterfowl and vegetation. As nesting site it usually chooses a very old tree. It is a resident bird which breeds in the winter when scores of waterfowl provide a good supplement to the fish food.

During our waterfowl surveys we surveyed about 50 different lakes, probably the best lakes of the country. The result was a population of 26 pairs of this eagle only! We did not explore the numerous dhands and jheels situated in the desert east of the Nara, but we have a strong impression that its total population in Pakistan does not exceed 40 or 50 pairs, perhaps much less!

List of lakes where we observed the Pallas's Fishing Eagle:

Lal Suhanra
Ghauspur
Haleji
Chateji
Dho
Maboobshah
Jafferli
Phoosna
Taunsa Barrage
Manchar
Sadori
Sanghriaro
Soonahri
Jamrao Head
Borthie
Dabhko
Charwo

Also the Indus near Sukkur, and canals around Badin.

A serious threat to this species is the disappearance of old trees around the lakes. Pakistan is densily populated and big trees are the only safe places left for nesting. It might be an interesting experiment to offer man-made nests for the birds in areas where old big trees are absent. A good protection and conservation of both habitat and the birds is urgently needed.

CINEREOUS VULTURE *Aegypius monachus*

A resident vulture breeding in Baluchistan and NWFP. Is seldom seen in the plains of the Indus. Twenty observations only. Most of our sightings are from the surroundings of Karachi where it frequents the rubbish dumps with numerous other species of raptors. Other observations are: 2 birds near Hyderabad on 17-i-1974, 2 near Attock on 1-ii-1973 and 2 at the Chasma Barrage on 2-ii-1973.

GRIFFON VULTURE *Gyps fulvus*

A breeding bird of the Khirtar Range and the Himalayas. It can be seen regularly in the surroundings of Karachi where up to 15 birds visit the rubbish dumps. They perhaps orginate from the Khirtar. Regular visitor to the plains and deserts of Lower Sind: 2 near lake Sadori (Sanghar), 2 near Boharo and 7 near the lake Hadero on 15, 17 and 22 February 1973 respectively. Is also regularly seen around Kamber (Larkana district). Two records from more northern regions: 14 near the Chasma Barrage on 2-ii-1973 and 5 N of Saidu in Swat on 4-iv-1970.

LONGBILLED VULTURE *Gyps indicus*

In the Salt Range we often observed vultures which we identified as Griffon Vulture. Other authors regard those vultures as belonging to the species *Gyps indicus.* So far we never where sure having seen this species. On the ground their small size struck us but we could not see any difference with the plumage of the Griffon Vulture. I doubt whether the birds are a different species from *Gyps fulvus.*

There is a small colony on the rocks in the pass between Kushab and Talagang. Other records are from the same area near Chakwal, Ucchali and Kalar Kahar.

WHITEBACKED VULTURE *Gyps bengalensis*

The commonest vulture in Pakistan. Our total number of sightings is 1725 but certainly very low as we did not survey all the parks or refuse dumps in the big cities. Many colonies are situated in parks or along tree-lined canals or roads. Well distributed all over the valley of the Indus.

EGYPTIAN VULTURE *Neophron percnopterus*

In winter the Egyptian vulture can be found on the rubbish dumps in the big cities where it feeds along with the other vultures and kites. Concentrations seldom exceeding 40 birds. In winter it is absent from the higher parts of Pakistan (Salt Range and many parts of the NWFP).

Our total of 229 records shows that it is less abundant than the Whitebacked Vulture but more widespread than the Griffon.

LAMMERGEIER *Gypaetus barbatus*

The distribution of the Bearded Vulture is restricted to the mountainous parts of Asia and Europe. We have no records from the Indus Valley. All three observations from rocky parts: 1 near the Warsak Barrage (NWFP); 1 at the Khyber pass and 1 N of Saidu (Swat).

HEN HARRIER *Circus cyaneus*

Rather scarce winter visitor to Pakistan. Fourteen observations only. Usually this species winters at higher altitudes.

PALE HARRIER *Circus macrourus*

The commonest of the "slender" harriers. A total of 57 observations, mainly from Sind. In this province we observed an average of 0.3 bird in a stretch of 10 miles.

MONTAGU'S HARRIER *Circus pygargus*

Scarce winter visitor. Three observations only. Identification of females is difficult. In Sind the species might be more common than *Circus cyaneus*. Its main wintering grounds are probably situated more S of Pakistan.

One bird was seen between Thatta and Badin on 13-i-1974. Two records of birds on migration, both in the Salt Range on March 30 and 31, 1970.

MARSH HARRIER *Circus aeruginosus*

Abundant winter visitor to the lakes and marshes of Pakistan. The total population consists of several hundred birds. Sind with its numerous lakes is the main wintering area in this part of Asia.

List of lakes with their estimated populations

Rasoul Barrage	15	Kheski	1
Chasma Barrage	15	Kharrar jheel	1-2
Khabakki	1 or 2	Marala Barrage	1
Nammal	1 or 2	Lake Rawal	1-2
Ucchalli	1 or 2	Manchar	20
Kalar Kahar	1 or 2	Mehar	3
Taunsa Barrage	3 or 5	Maboobshah	3
Lal Suhanra	10	Sanbher	7
Ghauspur	20	Dho, Thalli	1-2
Drigh	5 to 7	Phoosna	4-8
Langh	3 to 4	Atch	4
Haleji	30	Sadori	20
Kalri	30	Nungru	8
Hadero	5 or 6	Klanghar	3
Sandho	5	Kambar	3
Jafferli	1	Jamrao head	2
Charwo	4 or 5	Ladia	2
Soonari	5 to 10		
Sangriaro	8 to 10		
Gujo	3		

In seasonally flooded areas and in many other humid areas the Marsh Harrier can be found. Therefore the list is far from complete. It however gives a rough impression about the common occurrence of this harrier.

SHORT-TOED EAGLE *Circaetus gallicus*

A rare bird in all parts of Pakistan except in Lower Sind were it is a winter visitor in small numbers. It probably leaves the mountains in order to winter close to the Rann of Kutch. Between January 11 and 14 we observed a total of 17 birds in the surroundings of Badin, Ladiun, Sujawal and Seerani (1974).

Two other records probably concern migrants: One on 24-2-1971 SE of Islamabad, and one bird at Lal Suhanra in the month of April (1970).

OSPREY *Pandion haliaetus*

The valley of the Indus is perhaps one of the main wintering areas of the Osprey in

Asia. The Sind lakes are well provided with fish and for this reason we still encounter this raptor in good numbers. It probably is also common along the coasts of Pakistan. On a boat trip from Karachi to Ketti Bandar on 20 and 21 February 1972 we observed 8 Ospreys. Other high numbers were seen at Ghauspur where usually up to 10 birds can be found. The highest count was 16 birds at lake Hadero on 3 January 1974!

KESTREL *Falco tinnunculus*

In winter the Kestrel is the commonest falcon in Pakistan. A total of 69 observations. We had the impression that the Kestrel prefers the drier habitats like deserts and rocky areas (Salt Range, Kohistan).

MERLIN *Falco columbarius*

Rare winter visitor. One observation only. A female on 5-ii-1973 at the Taunsa Barrage.

REDHEADED MERLIN *Falco chicquera*

This magnificent falcon used to be commoner than at present. A total of 14 sightings; all observations from the middle and southern parts of the country: Thatta district, Larkana district and near Bahawalpur.

SAKER FALCON *Falco cherrug*

A rare winter visitor to the Indus valley. One observation of a bird on 22-i-1975 near the Rann of Kutch.

LAGGER FALCON *Falco biarmicus*

Nowadays quite a rare birds in Pakistan 14 observations only. Distribution not confined to certain provinces.

PEREGRINE FALCON *Falco peregrinus*

Like the other big falcons a rather rare raptor which usually can be found near coasts or lakes where waders or ducks concentrate. A pair can usually be seen at lake Rap near Ghauspur. One bird was seen on 17-ii-1971 near Karachi where it seems to be a regular winter visitor. On 21-ii-1972 we observed a bird near Ketti Bandar, and on 17-ii-1973 another at lake Hadero.

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Finally we have to thank Dr. L. Hoffmann who enabled us to do the waterfowl surveys.

Fungal flora of Panhala[1,2]

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Panhala hill fort (16°48′ N, 74°8′ E), is situated 13 miles south-east of Kolhapur city in Maharashtra. The altitude at the base of the fort is 856 metres and the plateau 398 metres above sea level. The annual rainfall varies from 187 to 200 cm and most of it is received between June to September. March-April are the driest months. Occasional showers start from May. The temperature goes upto 32-33°C during the hotter parts of the year, particularly in April-May; and falls to 25-26°C during December-January. The temperature fluctuation is about 7°C throughout the year.

Panhala is being developed as a hill station, and a number of new buildings are being constructed. The population is increasing fast. This already has had an adverse effect on the natural vegetation of this place. Possibly within next 15-20 years the area may loose a number of its important plants. It was, therefore, felt that an estimate of its present flora may be useful.

In this paper only the fungal flora is given. The fungi are arranged alphabetically under their respective classes. The total number of species listed during the period 1971-1972 are Phycomycetes 35, Ascomycetes 125, Basidiomycetes 120 and Fungi imperfecti 150.

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[2] Part of Research Project "Flora of Panhala" financed by Shivaji University, under research grant-scheme during 1971-1972.

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Phycomycetes

Albugo bliti (Pers.) Kuntze. On leaves of *Achyranthes aspera, Alternanthera sessilis.*

A. candida (Pers.) Kuntze. On *Raphanus sativus.*

A. evolvuli (Damle) Safee & Thirum. On leaves of *Evolvulus alsinoides.*

Albugo portulaceae (DC.) Kuntz. On leaves of *Portulaca oleracea.*

Bremia graminicola Naoumoff. var. *indica* Patel. On leaves of *Arthraxon serrulatus.*

Choanephora simsoni Cunn. On flowers of *Zinnia elegans.*

Circinella spinosa van Tregh. & Le Monnier. On fruits of *Artocarpus integra.*

Mucor indicus Linder. On dung.

M. mucedo (L.) Brefeld. Causing soft rot on *Annona reticulata, Arachis hypogea.*

Peronospora parasitica (Pers.) de Bary. On leaves of *Raphanus sativus.*

P. rumicis Corda. On leaves of *Rumex vesicaris.*

P. trigonellae Gaum. On leaves of *Trigonella foenumgruecum.*

Physoderma aeschynomeni Thirum & Whitehead. On submerged portion of *Aeschynomene indica.*

P. commelinae Lingappa. On leaves of *Commelina forskalaei.*

P. schroeteri Krieger. On leaves of *Cyperus rotundus.*

Phytophthora colocasiae Racib. On leaves of *Colocasia antiquorum.*

P. parasitica Dastur. Causing fruit rot on *Artocarpus integra.*

Plasmopara vernoniae-chinensis Sawada. On leaves of *Vernonia cinerea.*

Pythium aphanodermatum (Edson) Fitzp. Causing soft rot of *Carica papaya, Coccinia indica, Cuminis sativus.*

Rhizopus arrhizus Fischer. On dung.

R. nigricans Ehrenb. Causing fruit rot on *Achras sapota, Annona squamosa, Artocarpus integra,* and *Ficus carica.*

Sclerospora graminicola (Sacc.) Schroet. On leaves and inflorescences of *Andropogon halepensis, Pennisetum typhoides* and *Setaria italica.*

S. sorghi (Kulkarni) Weston & Uppal. On leaves of *Sorghum vulgare.*

Synchytrium alysicarpi Ramkar & Sund. On *Alysicarpus tetragonolobus, A. vaginalis.*

S. balsamini Patil & Mahabale. On *Impatiens dalzelli.*

S. cylistae, Patil & Mahabale. On *Cylista scariosa.*

S. lepidagathidis Mundk. & Mahtre. On *Lepidagathis cristata.*

S. pogostemonis Patil & Mahabale. On *Pogostemon plectranthoides.*

S. tragiae Patil & Mahabale. On *Tragia muelleriana* var. *unicolor.*

Ascomycetes

Acanthostigma heterochaete Syd. & But. On leaves of *Alysicarpus vaginalis.*

Amphisphaeria carissae Tilak. On stem of *Carissa congesta.*

A. gymnosporiae R. Rao. On stem of *Bougainvillea spectabilis, Gymnosporia montana.*

Asteridiella subapoda Syd. On *Mallotus philippinensis.*

Asterina gymnosporae E. Castel. On leaves of *Gymnosporia montana.*

A. lawsoniae P. Henn. & Nyman. On *Lawsonia alba.*

A. malloti Sawada. On leaves of *Mallotus philippinensis.*

A. sphaerotheca Karst & Roum. On leaves of *Vitex negundo.*

A. spissa Syd. On leaves of *Jasminum malabaricum.*

Bagnisiella bougainvilleae R. Rao. On stems of *Bougainvillea spectabilis.*

B. celastrina Tilak. On stems of *Celastrus paniculata.*

B. mangiferae Tilak & R. Rao. On stems of *Mangifera indica.*

Balansia andropogonis Syd. On *Cymbopogon martinii.*

Balladyna autriani P. Henn. On leaves of *Xeromphis spinosa.*

B. velutina P. Henn. On leaves of *Pavetta indica.*

Balladyna sp. On leaves of *Canthium parviflorum.*

Calosphaeria lantanae Tilak & Nagre. On stems of *Lantana camara, Pongamia pinnata.*

Calospora tectonae Tilak & Rao. On stems of *Tectona grandis.*

Capnodium annonae Pat. On leaves and twigs of *Ficus glomerata* and *F. rumphii.*

C. citri Berk. & Desm. On leaves of *Citrus medica.*

C. eugeniarum Cooke. On leaves of *Jambosa vulgaris.*

C. ramosum Cooke. On leaves of *Mangifera indica.*

Chaetothyrium pongamiae Harris. On *Pongamia pinnata.*

Claviceps microcephala (Wall.) Tul. On *Pen-*

nisetum typhoides.

Clypeolella inversa V. Hohn. On leaves of *Celastrus paniculata.*

Daldinia concentrica (Bolt) Ces & de Not. On dead wood.

Diatrype mangiferae R. Rao. On stems of *Mangifera indica.*

Diatrype sp. On *Sapindus laurifolius.*

Diatrype sp. On stems of *Smilax zeylanica.*

Diatrypella cassiae Tilak. On twigs of *Cassia fistula.*

Diatrypella sp. On twigs of *Syzygium* spp.

Erysiphe graminis var. *tritici* Marshall. On leaves of *Triticum aestivum.*

E. matheranensis Visw. On leaves of *Leucas stelligera.*

Eutypella stellulata (Fr.) Sacc. On stems of *Celastrus paniculata.*

Hypoxylon rubiginosum (Pex.) Fr. On *Livistona chinensis.*

Hypoxylon sp. On dead wood.

Hysterium celastrina Tilak. On stems of *Celastrus paniculata.*

H. lantanae Tilak & R. Rao. On stems of *Lantana camara.*

H. tamarindii Tilak. On stems of *Bougainvillea spectabilis, Tamarindus indica.*

Hysterium sp. On *Dalbergia sympathetica.*

Irenopsis crotonis (Steu. & Theon) Steu. On leaves of *Pavetta indica.*

Lophodermium agharkarii Tilak. On leaves of *Syzygium cumini.*

Meliola allophylii Doidge. On the leaves of *Allophyllus serratus.*

M. brideliae Steu. & Rold. On leaves of *Bridelia squamosa.*

M. carrissa Doidge. On leaves of *Carrissa conjesta.*

M. canthi Hansf. On leaves of *Canthium parviflorum* and *Wendlandia thyrsoidea.*

M. cladotricha Lev. On leaves of *Syzygium cumini.*

M. jasminicola P. Henn. On leaves of *Jasminum malabaricum.*

M. kibirae Hansf. On leaves of *Xeromphis spinosa.*

M. cadgensis Yates. On leaves of *Glycosmis pentaphylla.*

M. diospyri Syd. On leaves of *Diospyros montana.*

M. indica Syd. var. *careyae* Stev. On leaves of *Careya arborea.*

M. osyridicola Hansf. On leaves of *Osyris wightiana.*

M. zizyphi Hansf. On leaves of *Zizyphus rugosa* and *Z. mauritiana.*

Mycosphaerella bombycina Visw. On leaves of *Syzygium cumini.*

M. cassiae Tilak. On leaves of *Cassia tora.*

M. indica Visw. On leaves of *Morus alba.*

Parodiella perisporioides (Berk. & Curt.) Speg. On leaves of *Alysicarpus vaginilis, A. tetragonolobus, Crotalaria linifolia, C. filipes, Desmodium rotundifolium, D. triflorum, Indigofera cordifolia,* and *Smithia conferta.*

Phyllachora ajrekari Syd. On leaves of *Ceropegia tuberosa,* and *Tylophora dalzellii.*

P. ambigua Syd. On leaves of *Syzygium cumini.*

P. bambusae (Syd. & Butler) But. On leaves of *Bambusa* sp.

P. bauhiniae (Wint.) Theiss. & Syd. On leaves of *Bauhinia purpurea.*

P. cassicola Ananth. On leaves of *Cassia tora.*

P. cynodontis (Sacc.) Niessl. On leaves of *Cynodon dactylon.*

P. dalbergiae Niessl. On leaves of *Dalbergia latifolia* and *Dalbergia sympathetica.*

P. dolichospora. On leaves of *Tinospora cordifolia.*

P. glycosmidis Petch. On leaves of *Glycosmis pentaphylla.*

P. graminis (Pers. & Fr.) Fuckel. On leaves of *Digitaria* sp.

P. ixorae Thesiss. & Syd. On leaves of *Ixora arborea.*

P. pongamiae (Berti & Br.) P. Henn. On leaves of *Pongamia pinnata.*

P. repens (Corda) Sacc. On leaves of *Ficus religiosa.*

P. themedae Ananth. On leaves of *Themeda quadrivalvis.*

Phyllactinia brideliae Patil. On leaves of *Bridelia squamosa.*

P. corylea (Pers.) Karst. On leaves of *Careya arborea, Cassia fistula,* and *Morus alba.*

P. indica Patw. On leaves of *Combretum ovalifolium.*

P. thirumalchari Pyak. On leaves of *Cordia dichotoma.*

Physalospora rhodina (Berk. & Curt.) Cooke. On *Mangifera indica.*

Plagiostigme deodikari Ananth. On leaves of *Syzygium cumini.*

Pleospora herbarum Rabenh. On stem of *Lantana camara.*

Prigsheimia alianthi Tilak & R. Rao. On stems of *Alianthus excelsa.*

P. cestri-nocturni Tilak & Kale. On leaves of *Cestrum nocturnum.*

Pseudopeziza rependa (Fr.) Karst. On leaves of *Rubia manjith.*

Rosenscheldiella eugeniae Petch. On leaves of *Syzygium* spp.

Taphrina maculans. On leaves of *Curcuma pseudomontana.*

T. rhomboidalis Syd. On leaves of *Pteris quadriaurita.*

Tryblidaria pongamiae R. Rao. On stems of *Pongamia pinnata.*

Tryblidiella rufula (Spreg) Sacc. On branches of *Bougainvillea spectabilis* and *Dalbergia sympathetica.*

Uncinula tectonae Salm. On leaves of *Tectona grandis.*

Xylaria apiculata Sacc. Saprophyte.

Xylaria dealbata Berk. & Curt. On wood.

Xylaria obovata Berk. On wood.

Xylaria sp. On dead leaves.

Xylaria sp. Saprophyte.

BASIDIOMYCETES

Aecidium argyreae Chavan. On leaves of *Argyreia hookeri.*

A. crini Kalch. On leaves of *Crinum asiaticum.*

A. lepidagathis-cuspidatae Chavan. On leaves of *Lepidagathis cristata.*

A. rhytismoideum Berk & Br. On leaves of *Diospyros montana.*

A. vangueriae Cooke. On leaves of *Meyna laxiflora.*

Aecidium sp. On leaves of *Ledebouria hyacinthiana.*

Aecidium sp. On leaves of *Barleria* spp.

Agaricus woodrowii Mass. On ground.

Agaricus sp. On ground.

Agaricus sp. On dung.

Auricularia epitricha Berk. On wood.

A. mesenterica Br. On wood of *Tectona grandis.*

Bollitus grandiusculus Cooke & Mass. On ground.

Calocera viscosa (Pers.) Fr. On wood.

Cerotelium fici (Butler) Arther. On leaves of *Ficus glomerata* and *Ficus* spp.

Chaconia butleri (Syd.) Mains. On leaves of *Jasminum malabaricum.*

C. tectonae Ramak. On leaves of *Tectona grandis.*

Clavaria lilacina. (Mont. & Berk.) Marqan. On ground.

Clavaria sp. On ground.

Clavaria sp. On wood of *Tectona grandis.*

Cyathus microsporus Tull. On wood & on ground.

C. sterconcus (Schw.) de Toni. On ground.

Dasturella divina Syd., Mundk. & Kheshwala.

On leaves of *Dendrocalamus strictus* and *Xeromphis spinosa*.

Entyloma globigenus Thirum. & Safee. On leaves of *Blumea lacera*.

Fomes senex Nees & Mont. On wood.

Ganoderma applanatum (Pex.) Pat. On tree trunks.

G. colosum Bers. On tree trunks.

Graphiola sp. On leaves of *Phoenix sylvestris*.

Hemileia pavetticola Mubl. & Roger. On leaves of *Pavetta indica*.

H. themasii Thirum & Narasim. On leaves of *Xeromphis spinosa*.

H. vastatrix Berk. & Broome. On leaves of *Coffea arabica*.

H. woodii Kal & Cooke. On leaves of *Meyna laxiflora*.

Hymenochaeta cacao. On wood.

Hymenochaeta sp. On wood.

Kamatomyces narasinhani (Thirum) Sathe (*Masseela narasimhani*). On leaves of *Securinega leucopyrus*.

Kueheneda flacourtiae (Mundk. & Thirum). On leaves of *Flacourtia indica*.

Kulkarniella pavettae Gokhale & Patel. On leaves of *Pavetta indica*.

Lenzites sp. On wood.

Liora emodenis (Berk.) Cif. On *Polygonum chinense*.

Melampsora helioscopiae Wint. On leaves of *Euphorbia geniculata*.

M. ricini (Beauv.) Pass. On leaves of *Ricinus communis*.

Olivea colebrookiana Thirum & Yadv. On leaves of *Colebrookia oppositifolia*.

Phakopsora phyllanthi Diet. On leaves of *Phyllanthus* ssp.

P. zizyphi-vulgaris Diet. On leaves of *Zizyphus mauritiana*.

Phragmidiella heterophragmae (Mundk. & Thirum) Thirum & Mundk. On leaves of *Heterophragma quadrilocularis*.

Physopella stakmani Sathe. On leaves of *Heterophragma quadrilocularis*.

Plerotus membranaceus Mass. On Trunks.

Polyporus campbelli Berk. On ground.

P. gramocephalus Berk. On trunks.

P. umblicatus Berk. On wood.

Polystictus occidentalis Kolotzsch. On wood.

Polystictus sp. On wood.

Puccinia arthraxonis Syd. & Butler. On leaves of *Arthraxon* sp.

P. colletiana Barklay. On leaves of *Rubia manjith*.

P. graminis Pers. var. *tritici* Erik. & P. Henn. On leaves of *Triticum aestivum*.

P. helianthi Schw. On leaves of *Helianthus annus*.

P. heterospora Berk. & Curt. On leaves of *Abutilon indicum*, *Sida glutinosa* and *Sida acuta*.

P. leucadis Syd. On leaves of *Leucas stelligera*.

P. nakanishikii Diet. On leaves of *Cymbopogon martinii*.

P. prainiana Barklay. On leaves of *Smilax zeylanica*.

P. solmsii P. Henn. On leaves of *Polygonum chinense*.

P. sorghi Schw. On leaves of *Sorghum vulgare* and *Zea mays*.

P. stenotaphri Cummins. On leaves of *Pennisetum typhoides*.

P. substriata El. Berth var. *indica* Ramachar & Cummins. On leaves of *Pennisetum typhoides* and *Solanum melongena*.

P. versicolor Diet. & Hdw. On leaves of *Lantana camara*.

P. wattiana Barklay. On leaves of *Clematis gouriana*.

Puccinia sp. On *Solanum indicum*.

Ravenelia acaciae-concinnae Mundk. & Thirum. On leaves of *Acacia concinna*.

R. breyniae-patentis. On leaves of *Melanthesa tuberinata*.

R. emblicae Syd. On leaves of *Cicca acida*.

R. hobsoni Cooke. On leaves of *Pongamia pinnata*.

R. kirganeliae Mundk & Thirum. On leaves of *Kirganelia reticulata*.

R. sessilis Berk. On leaves of *Albizzia lebbek*.

Schizophyllum alneum (L.) Schroet. On wood.

S. communae Fr. On wood.

Sorosporium pseudanthistriae Syd. & Butler. On *Pseudanthistria heteroclita*.

Sphaecelotheca bursa (Berk.) Mundk. & Thirum. On *Themeda quadrivalvis*.

S. sorghi (Link.) Clinton. On *Sorghum vulgare*.

Spherophragmium acaciae (Cooke) Magnus. On leaves of *Albizzia lebbek*.

Stereum hirsutum (Wall). Fr. On wood.

Stereum sp. On wood.

Trametes sp. On wood.

Throchodium sampathense Thirum. On leaves of *Argyreia elliptica* & *A. hookeri*.

Uromyces appendiculatus (Pers.) On leaves of *Phaseolus* sp.

U. clignyi (Pat.) Har. On leaves of *Chlorophytum laxum*.

U. commelinae Cooke. On leaves of *Commelina forskalaei* and *Cyanotis* sp.

U. hobsoni Vize. *Jasminum malabaricum* and *J. grandiflorum*.

U. orientalis Syd. On leaves of *Indigofera cordifolia*.

Ustilago cynodontis P. Henn. On *Cynodon dactylon*.

U. scitaminea Syd. var. *sacchari-officinarum* Mundk. On *Saccharum officinarum*.

FUNGI IMPERFECTI

Alternaria crassa (Sacc.) Rand. On leaves of *Datura* sp.

A. dioscoreae V. Rao. On *Dioscorea bulbifera*.

A. gomphrenae Togashi. On leaves of *Gomphrena celosioides*.

A. ricini (Yoshii) Hansford. On leaves of *Ricinus communis*.

A. sesami Kawamura. On leaves of *Sesamum indicum*.

A. solani (Ellis & Mart.) Jones & Grout. On leaves of *Solanum melongena* and *Solanum indicum*.

A. tenuis Auct. On leaves of *Arachis hypogea, Bougainvillea spectabilis, Coccinia indica, Cassia tora, Cocos nucifera, Musa paradisiaca, Phaseolus vulgaris, Vitis* sp. and *Zea mays*.

Alternaria tenuissima (Fr.) Wilshine. On leaves of *Polyalthia longifolia*.

A. zinniae Pape. *Ageratum* sp., *Blumea* sp. and *Helianthus annus*.

Ascochyta caryotina V. Rao. On leaves of *Caryota urens*.

Aspergillus niger Van Teigh. On *Arachys hypogea, Emblica officinalis*, and *Mangifera indica*.

Beltrania mangiferae Munjal & Kapoor. On leaves of *Mangifera indica*.

Bispora muhlenbeckiae Chiplonkar. On Phylloclades of *Muhlenbeckia platyclodos*.

Cephalosporium curtipes var. *predinicola*. On rusts. *Olivea colebrookiana, Chaconia tectoniae*.

Cercospora acalyphae Peck. On leaves of *Acalypha ciliata*.

C. achyranthina Thirum. & Chupp. On leaves of *Achyranthes aspera*.

C. agharkarii Chidd. On leaves of *Grevillea robusta*.

C. ailanthicola Patw. On leaves of *Ailanthus excelsa*.

C. arachidicola Hori. On leaves of *Arachys hypogea*.

C. blepharidia Chidd. On leaves of *Blepharis asperrima*.

C. blumeicola Das. On leaves of *Blumea lacera*.

C. caladii Cooke var. *colocasiae* V. Hochn. On leaves of *Colocasia esculenta.*

C. careyae Ramekar. & Ramekar. On leaves of *Careya arborea.*

C. cassiocarpa Chupp. On leaves of *Cassia tora.*

C. citrullina Cooke. On leaves of *Coccinia indica.*

C. cocculi Syd. On leaves of *Cocculus macrocarpus.*

C. consimilis Syd. On leaves of *Vernonia cinerea.*

C. crassa Sacc. On leaves of *Datura metal.*

C. elaegnicola Chidd. On leaves of *Elaeagnus conferta.*

C. fici-religiosae Chidd. On leaves of *Ficus religiosa.*

C. fleuryae Thirum & Govindu. On leaves of *Fleurya interrupta.*

C. fukushiana (Mat). Yam. On leaves of *Impatiens balsamina.*

C. gymnosporia Visw. On leaves of *Gymnosporia rothiana.*

C. jasminicola Muller & Chupp. On leaves of *Jasminum malabaricum.*

C. kamatense Chidd. On leaves of *Cryptolepis buchnani.*

C. koepkei Kruger. On leaves of *Saccharum officinarum.*

C. lepidogathida Thirum. & Govindu. On leaves of *Lepidagathis cristata.*

C. leucadis Thirum. & Govindu. On leaves of *Leucas stelligera.*

C. nebulosa Sacc. On leaves of *Althea rosea.*

C. pavetticola Thirum. & Govindu. On leaves of *Pavetta tomentosa.*

C. personata (Berk. & Curt.) Ell. & Ec. On leaves of *Arachis hypogea.*

C. pogostemonis Chidd. On leaves of *Pogostemon plectranthoides.*

C. randiae Thirum & Govindu. On leaves of *Xeromphis spinosa.*

C. smilacis Thuem. On leaves of *Smilax zeylanica.*

C. solani-nigri. Chidd. On leaves of *Solanum nigrum.*

C. tectoniae Stevens. On leaves of *Tectona grandis.*

Ciliochorella magniferae Syd. On leaves of *Mangifera indica.*

Cladosporium herbarum. On *Mangifera indica.*

C. glenosporoides Sacc. On leaves of *Meyna laxiflora.*

Cladosporium sp. On leaves of *Xeromphis spinosa.*

Colletotrichum capsici (Syd.) Butler & Bisby. On fruits of *Capsicum annum.*

C. falcatum Went. On leaves and culms of *Saccharum officinarum.*

C. graminicolum (Ces.) Wilson. On leaves of *Sorghum vulgare.*

Curvularia lunata (Wakker) Boedijn. On *Carica papaya.*

Cylindrosporium mappiae Thirum. & Narasim. On leaves of *Nothopodytes foetida.*

Dendrogliphium kamatii. V. Rao. On twigs.

Diplodia argyriae Chippionkar. On *Argyreia hookeri.*

D. natalensis Evans. On *Mangifera indica* and *Trichosanthes bracteata.*

Exosporium fici Payak & Thirum. On leaves of *Ficus benghalensis.*

Fusarium oxysporum Schl. On *Capsicum annum, Zizyphus mauritiana.*

F. roseum Link. On *Musa paradisiaca.*

Fusarium sp. On *Arachys hypogea* and *Annona squamosa.*

Fusicladium pongamiae Syd. On leaves of *Pongamia pinnata.*

Gloeosporium artocarpi Delacr. On fruits of *Artocarpus integra.*

G. mangiferae P. Henn. On *Mangifera indica.*

Helminthosporium oryzae Breda de Hann. On

Oryza sativa.

H. sacchari Butler. On leaves of *Saccharum officinarum.*

H. turcicum Passer. On leaves of *Zea mays.*

Isariopsis indica Gopinath. On leaves of *Zizyphus mauritiana.*

Macrophomina phaseoli (Maubl.) Ashby. On *Arachys hypogea, Saccharum officinarum* and *Sorghum vulgare.*

Microdiplodia caryotae V. Rao. On leaves of *Caryota urens.*

Monochatia sp. On leaves of *Bridelia stipularis.*

Oidiopsis balsaminae Rajderkar. On leaves of *Impatiens balsamina.*

O. euphorbiae Desphande & Rajderkar. On leaves of *Euphorbia* sp.

O. taurica (Lev.) Salm. On leaves of *Ricinus communis, Solanum melongena.*

Ovularia hydrabadense Salam & Rao. On leaves of *Euphorbia geniculata.*

Penicillium digitatum Sacc. On fruits of *Citrus* spp.

Penicillium sp. On *Mangifera indica* and *Emblica officinalis.*

Periconia medreeya Subbram. On leaves of *Cynodon dactylon.*

Pestalotia eugeniae Thirum. On leaves of *Syzygium cumini.*

P. ixorae Rangel. On leaves of *Ixora arborea.*

Phoma palmarum Cooke. On *Cocos nucifera.*

Phoma sp. On fruits of *Annona* and *Mangifera.*

Phyllosticta artocarpicola Batista. *Artocarpus integra.*

P. bougainvillicola V. Rao. On leaves of *Bougainvillea spectabilis.*

P. cassiae torae V. Rao. On leaves of *Cassia tora.*

P. cestricola V. Rao. On leaves of *Cestrum nocturnum.*

P. coffeicola Speg. On leaves of *Coffea arabica.*

P. cycadina Passer. On leaves of *Cycas revoluta.*

P. gymnosporicola V. Rao. On leaves of *Gymnosporia rothiana.*

P. lohogadensis V. Rao. On leaves of *Bridelia squamosa.*

P. phascolina Sacc. On leaves of *Phaseolus* sp.

P. polyalthicola V. Rao. On leaves of *Polyalthia longifolia.*

P. pongamiae Syd. On leaves of *Pongamia pinnata.*

P. pothosinae V. Rao. On leaves of *Pothos scandens.*

P. religiosa Syd. On leaves of *Ficus religiosa.*

P. zinnae P. Brun. On leaves of *Zinnia elegans.*

Phyllostictina tinosporae Syd. On leaves of *Tinospora cordifolia.*

Piricularia orzyae Cav. On leaves of *Oryza sativa.*

Ramularia tinosporae Thirum & Lacy. On leaves of *Tinospora cordifolia.*

Rhincosporium sp. On *Digitaria* sp.

Selenophoma kamatii Kalani. On leaves of *Syzygium cumini.*

S. terminalae Thite. On fruits of *Terminalia chebula.*

Septoria arcuata Cooke. On leaves of *Ficus* sp.

S. colebrookiae Sukapure & Thirum. On leaves of *Colebrookea oppositifolia.*

S. pulicariae Sukapure & Thirum. On leaves of *Pulicaria wightiana.*

Sphacelia sorghi McRae. On *Sorghum vulgare*

Volutella cassiicola V. Rao. On *Cassia* sp.

Zygosporium oeschoides. On leaves of *Cocos nucifera.*

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Parturition in the Indian False Vampire Bat, *Megaderma lyra lyra* Geoffroy[1]

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(*With a plate*)

Details of parturition in the Indian False Vampire Bat *Megaderma lyra lyra* are described here based on the observation of 11 normal deliveries, where a single young one was brought forth by each mother, and one unique case, where the mother delivered still-born twins, a male and a female. The mother remains hanging in her normal posture (head down) by only her right leg during the entire period of labour, and delivers the young with head presentation. It takes on an average 97 minutes for normal delivery. The mother eats the placenta completely. The eyes of the young open within a few minutes after the head emerges out. The young one is active and moves the head vigorously even before the body is completely out of the vagina.

Introduction

Although voluminous literature has accumulated on the various aspects of reproduction, the details of parturition are known with regard to a few species only such as *Tadarida brasiliensis cynocephala* (Sherman, 1937), *Artibeus planirostris* (Jones, 1946), *Myotis lucifugus lucifugus* (Wimsatt, 1945, 1960), *Hipposideros speoris* and *Cynopterus sphinx* (Ramakrishna, 1950), *Corynorhinus rafinesquei* (Pearson *et al.*, 1952), *Rhinopoma kinneari* (Anand Kumar, 1965) and *Pipistrellus ceylonicus chrysothrix* (Gopalakrishna & Madhavan, 1971).

The present paper embodies observations on the details of parturition in *Megaderma lyra lyra*, the Indian False Vampire Bat. This species conceives in November and delivers the young in the second half of the following April (Gopalakrishna, 1950; Ramakrishna, 1950; Ramaswamy, 1961; Brosset, 1962). A single young is delivered by each female during each pregnancy, which is usually carried in the left uterine cornu and rarely in the right (Gopalakrishna, 1950).

Material and Methods

Twelve pregnant females of *Megaderma lyra lyra* carrying full term conceptuses were collected between 16th and 21st April, 1972 and were kept under continuous observation in the laboratory. Each specimen was kept in a separate glass cage with a wire mesh on the top. Ten deliveries took place during the day time between 11 a.m. and 5 p.m., while two deliveries between 6 p.m. and 10 p.m. 11 out of the 12 specimens delivered a single young each, while one exceptional specimen delivered two young ones, a male and a female, both still-born. A minute to minute record was

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Photograph of a female in mid-labour with the head of the young one completely out of the vagina. The eyes of the young are open.

made of the various events during each delivery. The timing mentioned in the present report relates to the average calculated from the observations on the 11 normal deliveries. The exceptional case has been mentioned separately.

Observations

1. Normal parturition

Prior to the onset of labour the female is restless and constantly changes her position in the cage. But, after the commencement of labour she does not normally change her place although she exhibits spasmodic contortions of her body. During the early stages of labour the mother remains in her natural freely hanging head-down posture and hangs with legs hooked wide apart to the wire mesh at the top of the cage. Micturition accompanied by puffing up of the lower part of the abdomen invariably occurs a few minutes before the mother exhibits more pronounced signs of labour. A few drops of clear thick fluid—presumably the amniotic fluid—oozes out of the vaginal opening about 25 minutes before the young one actually begins to emerge from the vaginal orifice. During this interval the mother frequently licks her vaginal orifice, which becomes alternately dilated and contracted several times. The abdominal wall of the mother exhibits a series of contractions, each series lasting about one minute, and consisting of about 75 to 100 violent twitches of the abdominal muscles. During such paroxysms the mother lifts her whole body as if she is applying some pressure on her abdomen and bends the head backwards and forwards, and the foetus appears to be moved inside the uterus. Each series of contractions is punctuated by a gap of 3 to 4 minutes, when the female appears to be at rest, and does not exhibit abdominal contractions. The mother licks the vaginal opening vigorously as the young starts emerging. Perhaps, the constant licking is intended to lubricate the vaginal orifice to facilitate the emergence of the young. Soon after a part of the head of the young emerges out of the vagina, the mother invariably withdraws her left leg from its attachment to the wire mesh and remains hanging only by the right leg until the young one is completely delivered, except when she is disturbed when she hooks her left leg also to the wire mesh of the cage. This happened whenever the cage was either moved slightly for better observation or whenever some one in the room made a sudden movement or spoke even gently. However, she invariably released her left leg from the roof of the cage within a short time after the disturbance was over. The free left leg of the mother is bent at the knee and does not take any active part in delivery. A period of about 20 minutes elapses between the first appearance of the head in the dilated vaginal opening and the entire emergence of the head. When the head of the young is completely out of the vaginal orifice the mother licks the head of the young one vigorously for a short time and then goes to rest for a period varying from 3 to 4 minutes. The eyes of the young open within 2 to 4 minutes after the entire head is out of the vaginal opening (see plate) and the young is able to move its eyelids. The mother becomes restless after the short period of rest, and experiences quick paroxysms of contractions of the abdominal muscles accompanied by violent contortions of the body as if the mother is trying to forcibly eject the young. The shoulders of the young one emerge out next after about 10 minutes after the emergence of the head. Until this stage the young does not make any apparent movement, but now onwards it frequently shakes its head vigorously and opens

its mouth emitting chirping noises. After a few violent contractions of the abdomen of the mother the entire body of the young is ejected out of the vaginal opening. About 18 minutes elapse between the time when the shoulders of the young emerge and the ejection of the young. Immediately after the young is completely delivered, the mother hooks her left leg also to the wire mesh at the top of the cage wide apart from the right leg, folds her wings round the young one and curves her head ventrally so as to prevent the young from falling down, and licks the young, and her own vaginal opening vigorously. The young is active and crawls about on the abdomen of the mother, and the mother also actively pushes the young towards the pubic teats with the help of her wings. The young soon catches hold of one of the pubic teats with its mouth and the other by the thumb of its forelimb. The hindlimbs of the young embrace round the neck of the mother and the claws of the feet of the young get hooked to the fur on the mother's neck. After a period of about 5 minutes, when the mother appears to rest and does not show any movement except the movements of breathing, she exhibits slow contractions of the abdomen at frequent intervals. The placenta starts emerging out of the vagina within 18 minutes after the birth of the young. It takes about six minutes for the whole placenta to come out of the vaginal opening during which time the mother continuously licks the placenta and appears to pull the placenta out. As the placenta comes out of the vaginal opening, the mother holds it by her mouth and chews up the placenta. The entire process of parturition starting from the time when the amniotic fluid oozes out from the vagina until the mother eats up the placenta takes place in about 97 minutes—the maximum period noted in the present series of observations being 132 minutes and the minimum being 76 minutes. The part of the umbilical cord which is not consumed by the mother dries up and shrivels within a few hours after delivery.

The back of the newly born young has a sprout of fine fur, which is dull grey in colour, while the rest of the body is nearly naked and pinkish. The average weight of the eleven young ones delivered was 10.25 g with 8.6 and 11.38 g being the lowest and the highest weights respectively. The average weight of the mother after delivery is 36.21 g.

2. Twin Birth

It was mentioned earlier that out of the twelve specimens, which were kept under continuous observations, there was an exceptional case of one female which delivered two young ones, a male and a female weighing 8 and 5 g respectively. The two young ones were still-born, and both were delivered with breech presentation. The smaller young one was delivered first, and the placenta remained in the uterus. The dead young remained hanging by the umbilical cord. The second young was delivered within 20 minutes after the first, and the placental disc of this young was ejected along with the young. Examination of the uterus revealed that the second young was carried in the left uterine cornu, and the placenta of the first was still in the right cornu. There was profuse bleeding and the labour lasted for about 4½ hours. The details of this exceptional case are described elsewhere.

Discussion

There are considerable variations amongst the bats with respect to the posture the mother assumes during delivery and the manner in which the young emerges out. In *Tadarida*

brasiliensis cynocephala (Sherman, 1937), *Cynopterus sphinx* and *Hipposideros speoris* (Ramakrishna, 1950) the young is delivered while the mother remains in its natural (head down) posture. On the other hand in *Myotis lucifugus lucifugus* (Wimsatt, 1945, 1960) the mother assumes an inverted posture (that is head up for the bats) during delivery. In *Corynorhinus rafinesquei* (Pearson *et al.*, 1952) and *Pipistrellus ceylonicus chrysothrix* (Gopalakrishna & Madhavan, 1971) the mother hangs to the ceiling horizontally by hooking the claws of the thumbs and toes to projections in the ceiling and converts her body into a cradle-like posture during delivery. In *Artibeus planirostris* (Jones, 1946) the mother releases one leg and remains hanging by one leg only during delivery. In *Megaderma lyra lyra* the mother remains in her natural (head down) posture, and invariably unhooks the left leg and remains hanging only by its right leg during delivery. The free leg does not take any active part during parturition.

With regards to the emergence of the young, it occurs by breech presentation in *Tadarida brasiliensis cynocephala* (Sherman, 1937) and in most of the vespertilionids (Wimsatt, 1945, 1960; Person *et al.*, 1952; Gopalakrishna and Madhavan, 1971), while delivery by head presentation occurs in *Cynopterus sphinx, Hipposideros speoris* (Ramakrishna, 1950), *Artebius planirostris* (Jones, 1946) and *Rhinopoma kinneari* (Anand Kumar, 1965). Normal delivery in *Megaderma lyra lyra* occurs by head presentation.

The time taken for the ejection of the placenta after the delivery of the young one varies amongst the different species so far studied being about two hours in *Artebius planirostris* (Jones, 1946) and five hours in *Myotis lucifugus lucifugus* (Wimsatt, 1945, 1960). In *Megaderma lyra lyra* the placenta is expelled out within 15 to 20 minutes after the emergence of the young.

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History of botanical explorations in Nepal[1]

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An attempt has been made in this paper to trace out the history of plant collection in Nepal. Plant collection in Nepal begins from the early nineteenth century when Buchanan-Hamilton visited the valley of Kathmandu in 1802. Later in 1820 Nathanial Wallich travelled from Raksaul in the south to Nuwakot collecting plants en route. Hooker (1848), Burkill (1907) and other English botanists like Polunin (1949), Sykes, Williams (1952), Stainton (1954) play important roles in increasing the botanical wealth of Nepal. Indian botanists are also active in the collection of Nepalese plants since 1929 when B. L. Gupta had made a trip in western Nepal. J. Banerji (1948), S. K. Banerji (1949), M. L. Banerji (1948-1965), and V. Puri (1954) collected plants from eastern as well as central parts of Nepal. M. L. Banerji had submitted his Ph.D. thesis on the Nepalese flora in 1958. Japanese expedition of 1952 in Central Nepal brought several new plants to light. Since 1960 University of Tokyo seems to be interested in the flora of Eastern Himalayas including Nepal.

In 1961 a National Herbarium was established in Kathmandu to preserve all the plants of Nepal collected through the Department of Medicinal Plants.

Introduction

Nepal, situated on the mid-Himalayas between 26°20′-30°10′ N and 80°15′-88°10′ E, has an area of 54,362 square miles, with an average length of 550 miles from Mechi river in the east to the Mahakali river in the west. The width varies from 150 miles to 90 miles. The major part of the country consists of high mountains and rolling hills, accounting for about 83 per cent of the total land area, the remaining 17 per cent is occupied by the flat lands of the Terai. The altitude varies from 500 to 29,000 feet. The vegetation varies from tropical to alpine.

1800 - 1900 A.D.

Kirkpatrick, 1793:

The botanical exploration in Nepal begins with the visit of Buchanan-Hamilton to Nepal in 1802, though a few years before Hamilton, Colonel Kirkpatrick had visited Nepal in 1793 on a political mission to the country. Kirkpatrick's book 'An Account of the Kingdom of Nepaul' published in 1811 gives a vivid sketch of the vegetation of Nepal from Terai at Birgunj to midland valley at Kathmandu. Most of his botanical descriptions include the Nepali vernacular names.

Hamilton, 1802:

Buchanan-Hamilton (1762-1829), later Sir Francis Hamilton visited Nepal during 1802 to 1803. He was the third superintendent of the Royal Botanic Gardens at Calcutta. In 1814 he succeeded Roxburgh, the second superintendent of the Garden. He returned to England in 1815 after making extensive tours in Nepal. Hamilton was perhaps the first botanist to visit Nepal. He was one of the most productive authors who worked for the East

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India Company. He visited Nepal only once with the mission of Captain Knox. Collecting information was not an easy task as he was unable to see anything beyond the road leading from the plains to the Kathmandu Valley where he stayed for eleven months. He had to rely on informants whom he himself had chosen. Concerning the country between Sikkim and Nepal proper, his information was chiefly derived from the five different sources. Among them was a slave of the King of Gorkha, who had been received into his service in order to bring plants from the Alpine regions. Finding him very intelligent, and a great traveller, Hamilton employed him to construct a map. He had also gone to the Company's territories all along the southern border of Nepal, from Sikkim to the headwaters of the Ganges, in order to collect information from people coming down from the mountains. This task seemed to have been completed by 1814. He took the plants collected here to England where they were worked by Don. His book 'AN ACCOUNT OF THE KINGDOM OF NEPAL' published in 1819 deals with the history of Nepal and contains chapters which describe the vegetation of Nepal.

Wallich, 1820:

The second botanist to visit Nepal was Nathaniel Wallich (1786 - 1854). He was the superintendent of the Royal Botanic Gardens, Calcutta from 1815 to 1835. He organized collecting expeditions to Nepal, Western Hindustan, Lower Burma, and made vast collections of plants which were studied by Candolle, Kunth, Lindley, Bentham and others. Wallich spent a year at Kathmandu (1820 - 1821) and collected plants intensively in the valley and along the wooded hills surrounding it. Although he was not allowed to go beyond the confines of the valley, he prevailed on pilgrims to bring him plants from the mountains surrounding the sacred lakes of Gossain Than, which lie at an altitude of 15,000 feet and are three to four day's march north of Kathmandu. They are visited annually, by thousands of pilgrims during the months of August and September, and it is from this locality that many interesting Himalayan plants were recorded for the first time by Wallich. His plants are described in his TENTAMEN FLORAE NEPALENSIS (1824).

These two Nepalese collections of plants (Hamilton, Wallich) were preserved in A. B. Lambert's extensive herbarium.

In 1825 and 1826 two volumes of PRODROMUS FLORAE NEPALENSIS by David Don appeared containing 766 species of phanerogams. This pioneer work was prepared by Don while he was employed as the librarian of Lambert. This book is actually the compilation of the flora of Nepal collected by Hamilton and contains the description of some of Wallich's Nepal plants. It includes some interesting horticultural plants as *Primula rotundifolia* and *Potentilla coriandrifolia,* which were not rediscovered until 1927. Don's book was written in standard Latin. Reviewing it John Lindley said it is 'written in so strange a language, that we can scarcely guess its name, unless, "with great facility, after three lessons of an hour each", without the incumbrance of previous education' (Stearn 1973, pp. 13). Don not only described many new species collected from Nepal but also formed new genera. *Trichosporum* and *Lysionotus* were recognised as two new genera by him for the plants collected by Wallich from Nepal, who had mistakenly identified them as *Incarvillea parasitica* and *Incarvillea* sp. respectively.

Hodgson, 1822-1843:

There has been a British resident at Kath-

mandu since 1817. In 1822 Sir Brian H. Hodgson came to Kathmandu and lived for about 21 years (1822 to 1843) in the valley. He was the first person to bring to the notice of western scientists the incredible variety of plants and animals of Nepal. As he was obliged to stay in Kathmandu by an order of the Nepalese court, he employed Shikaris or professional hunters to collect animals for him. His primary interests were ornithology and herpetology, and he did little plant collecting himself. However, he encouraged his fellow countrymen to look into the plant life of Nepal.

Hooker, 1848:

The third botanist to come to Nepal was Sir Joseph Dalton Hooker in 1848. His plan was to explore botanically little known region of Himalayas. Sikkim was chosen for him to explore by Lord Auckland and Dr. Falconer. During this trip Hooker entered into Nepal through the eastern border and collected plants in the valley of Tamur and Arun reaching as far north as Wallunchoongola. He wanted to cross, into Tibet, but the porters refused to go any farther north. He, therefore, returned to Sikkim.

Entry into Nepal was not an easy task for him. It was only with the help of Dr. Campbell, who had gained the friendship of Jung Bahadur, that he could get permission to enter and explore Nepal. No European at that time was allowed to travel anywhere except to and from the plains of India and valley of Kathmandu. Hooker was fully equipped with porters and instruments during his travelling. While traversing in Nepal his party consisted of fifty-six persons including himself, and one personal servant, a Portuguese half caste.

Hooker's travels in the eastern Himalayas are described in his book HIMALAYAN JOURNALS Vols. 1 & 2, published in 1855. These books are truly the classics in the botanical literature of the world. He reported on the general features, geography, vegetation, and climate of the region unknown to the western world at that time. Bower considered HIMALAYAN JOURNALS to rank with Darwin's Voyage of the Beagle, and Wallace's Malay Archipelago, 'these books forming a veritable trilogy of the golden age of travel in pursuit of science.' (Hutchinson 1964, pp. 23). The Nepalese plants which he collected are described in his books 'The Flora of British India, Vols. 1-7 (1875-1897), which are much exploited during the recent times also while describing the Nepalese flora.

Scully & Duthie:

Dr. J. Scully in 1876 and J. F. Duthie in 1880 to 1884 have been reported to have collected plants along the Mahakali river in the border of Kumaon and Doti Baitadi districts of west Nepal.

1900-1950 A.D.

Burkill, 1907:

On November 28th, 1907, after marching along nearly one hundred miles of the Nepalese frontier between Jainagar and Raksaul, I. H. Burkill turned into the Kingdom of Nepal and reached Kathmandu by the usual route on 2nd December. Thence with his friend, Lieut-Colonel J. Manners-Smith, the Resident, he visited the Trisuli Valley, in the neighbourhood of Niakot (Muwakot).

Burkill returned from Kathmandu to the plains by a route through Pharping, which diversified the first seventeen miles of the way. His dates of visit almost coincided seasonally with the dates of Wallich's march to Kathmandu, and it seems, Burkill and Wallich, gathered plants with a gap of 87 years the same plants in the same spots. Wallich had

thoroughly explored the areas he had visited so Burkill got no more new plant records but three species of *Impatiens* and apparently one *Eriocaulon*.

Burkill listed plants that he came across on his march to Niakot in a very descriptive way and compared the flora to that of adjoining areas of Bhutan and Sikkim. His 'Notes from a Journey to Nepal' (1910) gives about 470 plant species that he collected and refers to other plants reported from Nepal by Wallich.

Landon's Nepal, 1928:

Prior to 1928 the literature on Nepal was very meagre, but in that year were published two handsome volumes entitled 'Nepal' by Percival Landon (1928). This talented author was given special privileges by the Nepal authorities, so that this book was the most authoritative and comprehensive account of Nepal at that time, but he died before his fascinating account of Nepal was through the press.

Published as an Appendix XIV in the same book, Nepal, is 'Flora of Nepal', compiled under the authority of the Director of the Royal Botanic Gardens, Kew (from different sources such as D. Don's PRODROMUS FLORAE NEPALENSIS, N. Wallich's TENTAMEN FLORAE NEPALENSIS, Col. R. H. Beddome's FERNS OF BRITISH INDIA, Hooker's The FLORA OF BRITISH INDIA, Sir G. King and Pantling's THE ORCHIDS OF SIKKIM HIMALAYAS in Annals of the Calcutta Garden, Vol. III, I. H. Burkill's Notes from a Journey to Nepal (Records of the Botanical Survey of India, Vol. IV). This 'Flora of Nepal' consists of a list of 1672 phanerogams.

Wollaston, 1922:

In 1922 Balfour published some new species of plants collected by Mr. A. F. R. Wollaston, Medical Officer and Naturalist to the Mount Everest Expedition, 1921. The complete set of the whole collection was presented to the Royal Botanic Gardens, Kew, by the Mount Everest Committee. The new species from the neighbourhood of Mt. Everest described were *Aconitum orochryseum* Staff, *Tanacetum khartense* Dunn., *Anrosace sessiliflora* Turrill, *Primula buryana* Balf. f., *P. wollastonii* Balf. f., *P. younghusbandiana* Balf. f., *Gentiana stellata* Turrill, *G. tubiflora* Wall. var. *longiflora* Turrill, *Dracocephalum breviflorum* Turrill.

Collections between 1927-1949:

Between 1927 and 1931, two Nepalese collectors, Major Lal Dhwoj and Prof. Khadananda Sharma, made extensive journies in Nepal in search of herbarium specimens and horticultural treasures. They found some outstanding new and little known plants such as *Meconopsis regia, M. longipetiolata, M. dhwojii, Primula wigramiana, P. wollastonii, P. buryana, Cyananthus hayana, C. pedunculatus* var. *crenatus, Gentiana ornata*. Many of these plants were first grown by T. Hay in Hyde Park from seeds sent by these collectors and some of them are now well established in British gardens. It is difficult to follow the exact routes of these collectors owing to variation in the spelling of place names, but they covered most of East, Central and West Nepal, as far as the massif of Annapurna, and it is probable that they collected most of the conspicuous and attractive alpine plants of this area.

In the spring of 1929 with the permission and cooperation of the Nepalese Govcernment a botanical party consisting of Mr. Basant Lal Gupta, Botanical Assistant at the Forest Research Institute, Dehra Dun, and Bis Ram, collector, entered Nepal being joined by Ma-

jor Lal Dhwoj, a representative of the Nepalese authorities. It was the intention of the party to collect in the valley of the Karnali river in the neighbourhood of Simikot as this area was likely to be of considerable interest.

Unfortunately Mr. Gupta was taken seriously ill and had to be carried back from Silgarhi. The collector Bis Ram remained behind but it was a long time before instructions could be sent to him to continue the work alone. As the funds with which the party had started had to be divided an insufficient amount was left with the collector, which did not enable him to go more than 5 or 6 stages beyond Silgarhi. The area, explored, therefore, contained little of special interest. About five hundred plant species were collected during this expedition. These plants are listed in Forest Bulletin (Botany Series No. 76, 1931).

Major Lal Dhwoj was selected in 1928 by the then Prime Minister of Nepal for the task of collecting seeds and specimens. As a young man, Major Dhwoj had some botanical training in the Darjeeling Botanic Garden, and he had an eye for a good plant. In 1931 he died at his task and so did not live to receive the Gold Medal awarded to him by the Royal Horticultural Society. After the death of Dhwoj a very worthy successor had been found in the person of Professor K. N. Sharma; his botanical knowledge, care in the selection of specimens and seeds, the fulness of his field notes, and other qualities, was a pleasant surprise to botanical authorities in U.K.

Sir C. Wigram and Sharma collected plants from 1927 to 1931. The major set of their collection are preserved at the British Museum and have been little worked out so far as *Meconopsis, Primula* and *Gentiana.* Some parts of the collection are at the Herbarium, Royal Botanic Garden, Edinburgh.

During 1935 and 1937 Bailey collected plants in the valley and also sent collectors to west and central Nepal.

In 1948 J. Banerji visited the eastern part of Nepal in connection with the Kosi Project and collected plants in the valleys of Tamur river.

Dr. S. K. Banerji, Keeper of the Indian Botanic Garden that time collected plants along the Nepal-Sikkim border in 1949.

Polunin & Lowndes, 1949-1950:

In 1949 Oleg Polunin had the good fortune to be asked to join an expedition to the central Nepal Himalaya which was being organized by the Himalayan Committee. It was the first time since the memorable journey of Sir J. D. Hooker in 1848 to East Nepal, that a European party had been given permission to explore the mountains lying within the boundaries of Nepal.

The expedition was organized in the first place as a climbing expedition under the experienced leadership of Major H. W. Tilman, but on the recommendation of the then Prime Minister of Nepal, two scientists were included in the party. Their itinerary was the two mountain massifs lying on the Nepal-Tibet boundary, the Langtang Himal and the Ganesh Himal with peaks of 23,000 feet and 24,000 feet. Polunin visited Langtang, Rasua Garhi, and Chilime Khola to the north of Kathmandu, and found *Gentiana nubigena, Saussurea gossipiphora,* primulas and rhododendrons at an elevation of 16,000 feet. In 1950 Col. D. G. Lowndes collected seeds and plants in the vicinity of the Marsyandi River, Manangbhot, and the Jargeng Khola. Some of the high altitude plants collected by Col. Lowndes at 10,000 to 16,000 feet were: *Pedicularis, Primula, Lonicera, Ephedra* and *Delphinium.* The collections of Polunin and Lowndes, which went to the Herbarium of the

British Museum (Nat. Hist.) and which included the new species *Rhododendron cowanianum* and *Rh. lowndesii,* whetted the British appetite for further botanical collecting. A small list of flowering plants collected in Langtang area is published as an Appendix in Tilman's NEPAL HIMALAYA 1950.

1950-1974 A.D.

The revolution of 1950-1951 brought about a significant change in the outlook of the Government and people of Nepal toward foreigners, who were given greater freedom to explore the country in the post revolution period, and the many mountaineering expeditions that have come to Nepal since this period gave opportunity to a number of botanists to explore plant life in the Himalayas.

British Expeditions:

The British Museum (Natural History) started to send botanical expeditions to Nepal from 1952. In the spring of 1952 an expedition was organized jointly by the British Museum (Natural History) and The Royal Horticultural Society. The party consisted of three botanists, Leonard Howard John Williams, Oleg Polunin and William Russel Sykes. They explored an area of about 1000 square miles lying between the Karnali and Kali Gandaki rivers in western Nepal in the districts of Jumla, Humla, Jajarkote and Sallyan. As a member of the staff of the Royal Horticultural Society Gardens at Wisley, Sykes was trained as a botanical and horticultural collector. In the field they were assisted by six native collectors, some of whom had been on collecting journeys with both Ludlow and Sherriff, and Kingdon-Ward. The general plan of the expedition was to make direct for Jumla and using this village as their base, to work as 3 parties so that as much ground as possible could be covered. Each party was to consist of one European with two native collectors. The Nepalese Government provided each party with an escort of three constables and they found these men invaluable not only for their help in the often difficult task of obtaining coolies and food but also in assisting with the daily drying of their plant press papers.

In March 1954 another expedition was jointly sponsored by the British Museum (Natural History) and The Royal Horticultural Society to collect in central Nepal. The country south of the great mountain ranges of Dhaulagiri and Annapurna, and the drainage system of the Kali Gandaki river between and behind them, was then unknown botanically and zoologically. Besides Mr. John D. Adam Stainton and W. Sykes, who were both botanists, the party consisted of Mr. L. H. J. Williams (Botanist and leader), Mr. K. Hyatt (zoologist), Mr. J. Quinlan (entomologist), all from the British Museum (Natural History). In India they were joined by Dr. V. Puri of Meerut College, who remained with the expedition for nearly two months. They decided to make the little town of Pokhara, south of the Annapurna range, their main base because it possessed reasonable means of communication with the outside world, including a fairly regular air service to and from Kathmandu to the east and Indian border to the south. As in the case of the expedition of 1952, the 1954 expedition also decided to separate into three parties in order to collect over a larger area. It fell to Williams to work the area south of the Annapurna range, Stainton was to concentrate upon the area of the Upper Kali Valley towards the Tibetan border, while Sykes was to journey westward to the country to the south and south-west of the Dhaulagiri range. In the pary of Sykes, which was composed similarly to the other parties, he had

a Lepcha collector making his third plant-collecting expedition, a Bhotiya, who primarily came as a cook, and usually eight or nine porters each carrying about 60 lb. The latter were recruited locally, and those from the higher villages were usually very strong and hardy peoples of the Magar and Gurung branches of the Gurkha race.

These two big expeditions together with the previous ones of Polunin and Lowndes, brought back a total of over 17,000 gatherings of plants for the herbarium of the Museum.

After these expeditions Stainton became deeply interested in Nepalese flora. He took interest in the vegetation of Nepal since that time and after making many tours and collections in almost all parts of Nepal, Stainton wrote FORESTS OF NEPAL (1972) a very valuable book when considering the phytogeographical problems of certain plants.

All the gatherings of plants of Stainton went into the herbarium of the British Museum. In fact the number of gatherings from Nepal in the herbarium of the Museum totals probably around 40,000 at present. The enumeration of 'Flowering Plants of Nepal' by L. H. J. Williams which is being published quotes over 6,000 species.

Quite a large number of new species are noted for the first time as the outcome of these British expeditions. It is the intention of the British Museum 'to publish from time to time descriptions of new species and interesting records of plants represented in the extensive collections which have accumulated in the Museum from the Himalayas and neighbouring countries' (*Novitates Himalaicae*, 1955-62, p. 1). Some of the new species described are *Pedicularis pseudoregeliana, P. poluninii* (Tsoong 1955); *Saussurea chrysotricha, S. linearifolia, S. platyphyllaria* (Ludlow 1955-62); *Berberis mucrifolia* (Ahrendt 1956); *Saxifraga royleii, S. alpigena, S. williamsii, S. hypostoma, S. lowndesii, S. mira, S. poluniana, S. staintonii, S. rhodopetala, S. micans, S. cinerea, S. excellens, S. sphaeradena* subsp. *sphaeradena, S. namdoensis, S. lepida, S. glabricaulis, S. contraria, S. granulifera* (Smith 1958, 1960); *Silene helleboriflora* (Excell & Bocquet 1959-61); *Allium hypsistum* (Stearn 1960); *Epilobium staintonii, E. sykesii, E. brevisquamatum, E. williamsii, E. squamosum*, (Raven 1962); *Nepeta staintonii, Lamium tuberosum, L. staintonii, L. nepalense* (Hedge 1963-69); *Aconitum tamuranum, A. balangrense, A. staintonii, A. williamsii, A. amplexicaule, A. poluninii* (Lauener 1964); *Pedicularis annapurensis, P. armatoides, P. chamissonoides* (Yamazaki 1970); *Meconopsis taylorii* (Williams 1971); *Rubus acaenocaly, Begonia minicarpa, Bilderdykia filipes, Fagopyrum megacarpum, Impatiens williamsii, Pegaephyton minutum* (Hara 1972); *Elaeagnus kanaii* (Momiyama & Hara 1973); *Eriocaulon staintonii* (Satake 1973).

Mrs. Proud's Collections:

Mrs. Proud, the wife of Col. Proud, who was for a long time attached to the British Embassy at Kathmandu, had also been a regular collector for the British Museum but the list of her collections is not available. Writing about *Primula aureata* H. R. Fletcher says, 'In 1952, Mrs. Desire Proud sent to the Herbarium of the Botany Department of the British Museum, various fragments of plants which she had collected in Nepal. But among the fragments was an entire plant, in full flower and beautifully pressed, which Mr. Frank Ludlow recognised immediately as *P. aureata*. This is the only known specimen of the plant to have been collected in the wild and Mrs. Proud has given me details of the habitat. She found a small colony of five or

six plants on the steep slopes surrounding the head water of the Thadi Khola, a tributary of the Gandak, and some 20 miles as the crow flies (But 5 days on foot) almost due north of Kathmandu'. (Fletcher 1953, p. 177).

Japanese Expeditions:

In 1952, the reconnaissance party to Manaslu, Nepal, was organised by the Japanese Alpine Club (JAC). Kinzi Imanishi, an ecologist and anthropologist, and Mr. Sasuke Nakao, a botanist, member of both the Fauna and Flora Research Society (FFRS), and JAC, were elected to join. The party was organised originally to find a route to Manaslu, and consisted of six members under the leadership of Imanishi.

Again in 1953 the Himalayan Committee decided to send a party to scale Manaslu from the same side during the premonsoon season. Jiro Kawakita, an ethnologist and geographer, member of the FFRS and JAC, and Nakao joined the climbing party of the Manaslu expedition. On March 28, with an interpreter and seventeen porters, they separated from the climbing party at Panch Mane Bhanjyang which is a day's journey from Kathmandu. Nakao had joined the expedition especially to collect the plants from the Himalayan regions. He collected in central Nepal from September to December, 1952, entering the alpine belt up to the snow line, approximately 1000 dried specimens, seeds of both wild and cultivated plants, and stocks of perennial herbs and shrubs. In 1953 he made a botanical journey to central Nepal from April to August, and he devoted himself to herbs bringing about 4000 specimens and many seeds. Tadashi Fujimura, a member of the Annapurna Expedition of ACK collected about 250 specimens in central Nepal, from September to December, 1953. These herbarium specimens are preserved both in the Herbarium of the National Science Museum in Tokyo and in the Herbarium of the Botanical Institute, Faculty of Science, Kyoto University. The results of the above expeditions are published in three volumes. The first volume FAUNA AND FLORA OF NEPAL HIMALAYA is entirely devoted to the flora and fauna of Central Nepal and consists of 924 species of phanerogams. A number of new reports and new species of plants are described in this volume, some of them such as *Aristolochia nakaoi, Saxifraga nakaoi, Micromeria nepalensis, Corydalis nepalensis, C. mitae, Geranium nakaonum* are noteworthy.

FLORA OF EASTERN HIMALAYA was published in 1966 under the editorship of Hiroshi Hara. This book includes the scientific results obtained from the Botanical Expeditions to Eastern Himalayas by the University of Tokyo in 1960 and 1963. The main objects of their expeditions were to make clear the close botanical relationship between Eastern Himalaya and Japan, to investigate critically the corresponding taxa in both regions, and to analyse the process of evolution in the plant groups originating from a common ancestor in the Early Tertiary and now widely separated in both regions. They had, therefore, concentrated their effort to study the temperate flora of Eastern Himalaya in comparison with that of Japan. Their collections consisted of about 60,000 specimens of plants, in which many new species were noted. *Salix plectilis, Baliospermum nepalense, Tithymalus pseudosikkimensis, Liparis togashii, Malaxis tamurensis* are the new species described in this book. Among the newly reported plants *Tetracentron sinense* and *Hydrobryum griffithii* are important, as these plants throw some light on the affinities between the flora of Japan and east

Himalayas as their very close allies are found in Japan.

The Third Botanical Expedition to Eastern Himalaya (Bhutan, Nepal) in 1967 and the Fourth Expedition (Nepal, Sikkim) in 1969 were again organised by the University of Tokyo. The results of these expeditions are published in FLORA OF EASTERN HIMALAYA Second Report, in which new species from Nepal as *Eriocaulon exsertum, E. kathmanduense, E. obclavatum, Bulbophyllum otoglossum* are described. This book also includes supplementary remarks to an earlier volume of the FLORA OF EASTERN HIMALAYA and which was based on the data from the botanical expeditions by the University of Tokyo.

In 1963, from April to June, the Himalayan Expedition Club of the Chiba University organised an expedition to Eastern Nepal under the leadership of Makoto Numata, an ecologist. The target of this expedition was to climb Mt. Numbur (6954 m) and to carry on the vegetational analysis of the area in the vicinity of Numbur, which was carried out by Kyoji Yoda. Numata collected grasses, bamboos, weeds etc. from these areas and studied their ecological condition.

Swiss Expeditions:

In 1949 Wyss-Dunant collected plants in the north-east regions of Nepal. The two Swiss expeditions, one to the Everest in 1952 and the other to Gaurisankar in 1954, were also active in studying Nepalese plants and collecting them. These expeditions were jointly organised with the alpine expeditions. The first was led by Dr. Edouard Wyss-Dunant and Rene Dittert, leaders of the Swiss Expedition to the Everest, the second by Raymond Lambert. The botanical party was placed under the direction of Prof. Charles Baehni, director of 'Conservatoir et Jardin botaniques de Geneve'. The results of these expeditions are published serially in *Candollea.*

Banerji's Collections:

Since 1948 Mohan Lal Banerji had visited eastern Nepal collecting plants for a number of times. During his training at the Botanical Survey of India, 1947-49, one of the duties assigned to him was the cataloguing of the sheets of Nepal plants housed in the Calcutta Herbarium. In the course of this work he soon realised that Nepal was one of the botanically least known parts of Asia. This presented him a challenge and a problem, which he decided to tackle at the earliest opportunity. In 1948, he was on deputation with the Central Water Power and Irrigation Commission, which organised a Soil Conservation Expedition to East Nepal. In the course of his work as a botanist to the commission, he made an extensive collection of plants mainly from the Kosi Catchment area. These plants are now preserved in the herbarium of the Indian Botanic Garden, Calcutta.

This was his first experience in the study of the flora of Nepal in the field. On termination of the training scheme of the Botanical Survey of India in 1949, he joined the Meerut College, Meerut, and he was for several years given facilities to carry on his exploration of Nepal.

After his first visit to Nepal he decided to limit his field of exploration to East Nepal, as he thought, the whole of Nepal was too large an area for a single botanist to explore. In all, seven expeditions were organised to East Nepal between the years 1948 and 1957.

In 1958 Banerji submitted his Ph.D. thesis 'Contribution to Flora of Nepal' reporting 591 dicots. In the same year 'Botanical Exploration in East Nepal' was published in Journal of the Bombay Natural History Society reporting 169 species of flowering plants belong-

ing to 123 genera of 51 families. In 1965 he published 'Contribution to the Flora of East Nepal' in Records of the Botanical Survey of India giving short descriptions of 583 species of flowering plants belonging to 342 genera, out of 109 families of Dicotyledons only. In this paper a new variety of *Caltha palustris*, and of *Acer campbelli* are described.

Out of these expeditions Banerji found new species of *Pimpinella* and *Cuscuta* and named them as *P. clarkeana* and *C. santapaui*.

In the words of Banerji some of the results of explorations in East Nepal obtained by him are the following: (Banerji 1965)

'(i) The area which botanically was scarcely known previously, has been covered extensively, and large collections of plants have been made in it and at the same time abundant field notes taken on the spot.

(ii) As a result of the work, well over 75 new records have been established for the area under study. Further a number of new taxa have been described for the first time.

(iii) From the phytogeographical point of view this exploration has been able to produce a number of 'missing links' between the plants of the eastern and those of the western Himalayas. In this way the range of a large number of plants has been extended far beyond the previously known limits'.

Other Collections:

In 1953, John Tyson made a collection of plants in the vicinity of Api in west Nepal.

Oxford University organized an expedition to west Nepal in 1954. The original plans of the expedition were to explore the Saipal Group, east of Api. Dr. Harrington, leader of the expedition, was to carry out geological research, J. E. M. Arnold was the botanist collecting plants above 14,000 feet for the British Museum, Murray was to collect mice and lizards, also for the British Museum, I.F. Davidson was to study the people, with particular reference to their religion.

Seshagiri Rao Rolla was connected with the Indian Cho Oyu Expedition of 1958. He collected plants in the eastern Nepal during this expedition.

C. Jest in 1961 collected plants in North-West Nepal in the region of Dolpo and prepared a list of these containing 133 species of flowering plants. These plants are deposited in the Laboratoire de Phanerogamie, Museum National d'Histoire Naturelle, Paris.

Kazuhiro Itoh and S. B. Rajbhandari went on botanical survey of West Nepal along Ghurchi (3,000 m) and Khaptar (3,300 m) in 1963. The object of their survey was collection of general plants, especially the medicinal ones. During their survey about 1000 plant specimens were collected. A list of 132 plants with their notes is given in a report by Itoh. An extensive list of medicinal plants of Nepal with the corresponding Vernacular names also is given in it.

Rimal (1968) gave a list of gymnosperms collected in Kathmandu and its surrounding hills which include cultivated as well as wild ones.

Swan's Studies:

L. W. Swan, an ecologist, made two trips to the Nepal Himalaya, first with the American Himalayan Expedition to Makalu (27,790 ft) in 1954, and again in 1960 with Sir Edmund Hillary's Yeti hunting expedition. He collected plants and animals in the neighbourhood of Barun Glacier and certain other unnamed peaks in that region, and found evidence of life at the extreme altitudes of 19,000-22,000 feet. At 20,130 feet he found a small cushion plant (*Stellaria decumbens*) and in this area there was no evidence of other plants.

It seemed to him that this was near the upper limit for flowering plants; 'In all likelihood 20,130 feet stands as the highest altitude at which any living plant has been collected, though it is reasonable to expect that flowering plants can be found still higher.' (Swan 1960).

Rao's Collections:

C. R. Rao in 1967 published a paper entitled 'Plant Collection in Eastern Nepal' in *Indian Forester* in which he gave a list of 200 species of flowering plants he had collected belonging to 60 families. Rao's study was based on a number of botanical excursions undertaken in different parts of the Kosi Catchment at various seasons during the years 1950-1960 (Dr. K. George and K. B. Thapa), 1962-1963 (C. R. Rao). Plant collecting had been done upto an altitude of 2,592 m (8,500 ft) in Eastern Nepal. Out of these excursions Rao noted a new species of *Begonia* and described it under the name of *B. tribenensis.*

Dobremez's Studies:

J. F. Dobremez, an ecologist, came to Nepal in 1968 to carry on ecological studies. He started the preparation of the ecological maps which would cover the whole of Nepal. The series of maps published already are of Annapurna-Dhaulagiri, Jiri-Thodung and Kathmandu-Everest regions. In 1972 Dobremez published his thesis for D.Sc. on the ecology of Nepal Himalaya.

Activities of the Department of the Medicinal Plants:

Formerly the Department of the Medicinal Plants was just a small section of Botany (Banaspati Phant) which was established in 1937 in order to exploit and deal with the trades of crude herbs and drugs of Nepal. Prof. Khadananda Sharma, a chemist, was the head of this section. During this time a herbal farm in Shivapuri, north of Kathmandu at an altitude of 6,000 ft with about 3-4 acres of land was set up. Some important exotic herbs like *Digitalis purpurea, Saussurea lappa* and indigenous herbs like *Aconitum laciniatum* were cultivated. In 1961, a new plan was introduced for the development and research on the Nepalese crude herbs and drugs and a name Department of Medicinal Plants was given for this section. The Botanical Survey and National Herbarium is one of the sections of this Department. Twice or thrice a year the Department sends collecting expeditions to different parts of the country and the plants collected are preserved in the Herbarium section. At present there are more than 60,000 sheets of specimens housed in the Herbarium. It is expected that more than 6,000 species of flowering plants are present in Nepal. However, only about 3,500 species have been collected from different localities of Nepal.

In 1967 the first book 'Keys to the Dicot Genera in Nepal Part I (Polypetalae)' appeared which was the first venture of the Department published under the guidance of Dr. M. L. Banerji. The second book 'Keys to the Dicot Genera in Nepal Part II (Gamopetalae and Monochlamydeae)' of this series came out in 1968, which was the product of a joint venture of Mr. Tirtha Bahadur Shrestha of the Department and Dr. Dan H. Nicolson. These two books help much in identifying the dicot flora of Nepal both in the field and in the laboratory. Since 1967 the Department is publishing a series of flora of local regions like 'Notes on Flora of Rajnikunj' (1967), 'Flora of Phulchoki and Godavari' (1969), 'Flora of Nagarjun' (1973). These books are just the preliminary work of the Department for the preparation of a detailed 'Flora of Nepal'. The responsibility for the preparation of 'FLORA OF NEPAL' has been taken by the Department, and work is in progress.

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Food-habits of water-birds of the Sundarban, 24 Parganas District, West Bengal, India—VI[1]

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[*Continued from Vol. 72*(2):447]

DISCUSSION AND CONCLUSIONS

The food-habits of 24 species of water-birds of the Sundarban were studied during 1955-1960. In all 2617 birds were collected from the southeastern part of the 24-Parganas District covering both forested and reclaimed areas of a sector of the Sundarban.

The food of the birds has been ascertained on the basis of analysis of the contents of the crop and stomach of specimens collected in different seasons of the year, from different localities and habitats.

The specimens of birds were collected in the early morning and late evening hours just after their first and last meals, so that the stomach-contents were available in almost undigested or partially digested state. This permitted identification of the contents to a reasonable degree of accuracy.

The analysis of food of birds reveals that:

1. Some species of birds concentrate on a few species of prey (specialized diet), though on occasions the diet may vary to include some other species. For instance, the Openbilled Stork feeds mainly on gastropods but it may take reptiles, fishes and crabs also when the gastropods are difficult to obtain. The Darter's principal diet is fish but it may devour other aquatic organism also when fish population is inadequate.

2. In some species the diet is highly variable, for example the food of the Little Grebe is composed of fish, frogs, gastropods, crustaceans, insects, annelids, its own feathers and vegetable matter. Similarly the Grey Heron's food consists of mammals, birds, reptiles, frogs, toads, molluscs, crustaceans, insects, spiders, etc.

3. The diet of certain species varies seasonally, for example the Whitebreasted Kingfisher takes mainly aquatic organisms during the wet season (monsoon), but terrestrial ones during the dry season.

4. In species inhabiting different habitats, the diet varies according to the ecological niches the population lives in. For example, in the population of the Smaller Egret and Little Egret which inhabit creeks and marshes, the food consists of aquatic organisms, such as fish, frogs, water-insects, crustaceans, etc., but those residing in terrestrial habitat (cultivations, fallow lands) subsist on terrestrial insects, spiders, etc. In such species the food-habits are not very specialized. However, individuals of a species, e.g. the Little Cormorant, living on the brackish (creek) water organisms take mostly estuarine fishes and a very small amount of crustaceans but those thriving on the food available in fresh waters take

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mixed toll consisting of fish, frogs, water-insects, molluscs, crustaceans and vegetable matter.

5. Two factors appear to influence the choice of food, viz. size of the prey, and taste.

a) *Size of the prey.* The Darter has been found to prefer large-sized fishes (standard length 50-150 mm), the Openbilled Stork prefers large-sized Apple-snails (diameter 20-40 mm), the Grebe selects smaller fish-fry (standard length 5-40 mm), gastropods and aquatic insects.

b) *Taste.* The Grebe and the Smaller Egret have been found to avoid bugs; the Little Egret's meal does not contain either bugs or crustaceans.

6. The greater portion of the food of the majority of the birds examined consisted of fish and crustaceans. Such birds may be grouped as piscivorous and carcinovorous. The food of certain birds was found to consist mainly of insects and they may be classified as insectivorous. Birds under these categories are, therefore, of economic value. The piscivorous and carcinovorous birds that consume fishes and crustaceans of commercial importance are 'harmful' from the point of view of human economy, and the insectivorous birds that destroy insect pests of agriculture or those affecting public health may be regarded as 'beneficial', while those birds that cannot be accommodated under either of the categories are 'neutral'. The status of the various birds whose food-habits have been studied, may be given as:

A. **Harmful.** Under this category 13 species which affect fish, crustaceans and their fisheries may be included. Since the extent of damage done is variable, this category for convenience may further be subdivided as follows:

a) *Very harmful.* Fish and crustaceans together consumed over 75% of the total bulk of food.

b) *Moderately harmful.* Fish and crustaceans together consumed range between 50% and 75% of the total bulk of food.

c) *Less harmful.* Fish and crustaceans together consumed between 25% and 50% of the total bulk of food.

The 'harmful' birds are listed below under the three divisions showing the extent of damage caused to fish and fisheries by each:

Category	Percentage of wt. of commercial fish in relation to total wt. of food	Percentage of wt. of commercial crustaceans in relation to total wt. of food	Percentage of wt. of commercial fish and crustaceans in relation to total wt. of food	Remarks
Very harmful				
1. Little Cormorant	91.09	0.87	91.96	
2. Darter	81.20	1.00	82.20	
3. Large Egret	72.00	3.00	75.00	
4. Smaller Egret	75.00	2.00	77.00	in wet season
5. Little Egret	78.00	—	78.00	in wet season

Category	Percentage of wt of commercial fish in relation to total wt. of food	Percentage of wt. of commercial crustaceans in relation to total wt. of food	Percentage of wt. of commercial fish and crustaceans in relation to total wt. of food	Remarks
Moderately harmful				
1. Grey Heron	33.00	17.75	50.75	
2. Purple Heron	52.00	8.00	60.00	
3. Pied Kingfisher	57.00	17.00	74.00	
4. Little Green Heron	24.00	27.00	51.00	
Less harmful				
1. Little Grebe	22.8	8.5	31.30	
2. Openbilled Stork	4.59	25.37	29.96	in dry season
3. Whitebreasted Kingfisher	31.23	11.23	42.46	in wet season
4. Whiskered Tern	20.00	20.00	40.00	

B. **Beneficial.** Seven species may be included in this category, for they consume large quantities of insect-pests of agricultural crop and vegetables or insects that are nuisance to the public health and animal husbandry. They are:

Name	No. of ex. examined	Percentage of wt. of insect pests in relation to total wt. of food	Remarks
1. Cattle Egret	318	61.00	
2. Smaller Egret	220	79.00	in cultivated tract
3. Little Egret	138	71.00	in cultivated tract
4. Redwattled Lapwing	174	57.00	
5. Spotted Sandpiper	38	20.10	
6. Chestnut Bittern	8	15.00	
7. Whitebreasted Kingfisher	192	10.00	in dry season

C. **Neutral.** The following six species of birds may be included in the category.

1. Indian Moorhen
2. Night Heron
3. Cotton Teal
4. Coot
5. Bronze-winged Jacana
6. Little Stint

The study of food-habits of birds and their inter-relationships with other organisms reveal the complexity of the process. Birds have a definite role to play in the scheme of nature.

They are an important link in the chain which regulates balance of nature and maintains the biological equilibrium. The present problem has been studied in a limited area on limited number of species and is, consequently, limited in scope. Nevertheless, the present study has not only brought out some very interesting and highly useful data on economic ornithology, but also revealed the necessity of more intensive and extensive works on the problem so that it may be possible to utilize the results for the economy of the country.

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Some new records to the flora of Ladakh[1]

Gurcharan Singh and R. N. Gohil[2]

The paper is first in the series on the explorations of Floristic elements of Ladakh district. It puts on record 45 angiospermic species, hitherto unreported from the area. The collections are mainly from the southern part of the district.

Introduction

Subsequent to Stewart's (1916, 1917) compilation of the flora of Ladakh, many fragmentary reports have accumulated on the flora of this "high altitude desert" (Blatter, 1927-29; Mukerjee, 1940; Pennell, 1943; Ludlow, 1951; Chatterjee, 1953; Bor, 1960 and Stewart 1967a and b). However, none of these works is as comprehensive as that of Stewart's (1916, 1917) who has not only made floristic records but also described the physical features of the region. Although Stewart's (1916, 1917) work still remains monumental he has not been clear about the geographical limits of the areas referred to as Ladakh and this fact he has himself confessed.

Since the publication of Stewart's (1916, 1917) work the limits of the area have been specified and as such Ladakh today is not what it was in the twenties. This has necessitated a fresh floristic survey of the region, and hence the present project. So far, two trips have been made, during which about 400 plant species have been collected. As a first step towards the compilation of a comprehensive flora for the district we are putting on paper some new records.

The tour itinerary: In our first trip undertaken in July, 1970 the entire area between Zojila (3578 m) and Dras was scanned. The important places explored included Gumri, Machoi, Meenamarg, Matayan, Paan Dras and Dras. Large collections were made from the rich meadows of meenamarg (Meena = fish; marg = meadow, the fish shaped meadow). Beyond Kargil (2676 m) collections were made from Mulbeck (3275m), Bodh Kharbu (3420 m), Khalsi and Leh (3580 m).

In 1971 we went collecting up to Kargil. Thereafter we changed the route; following the course of river Suru. We proceeded towards Zanskar and on the way scanned Sanku (2930 m), Umba (3515 m) and Daphne (3120 m). The trip had to be abandoned at the foot of the Nun Kun peak (7135 m). On this route as well as in dry zones, typicals of the Ladakh landscape are common.

The voucher specimens of the plants reported in this communication have been deposited in the herbarium of the Department of Botany, Kashmir University.

List of Plants

Achillea millefolium Linn. Sp. Pl. 699, 1753. Dras (Gohil No. 1100), Dras (Gurcharan Singh No. 2747).

Aconitum rotundifolium Kar. & Kir. in Bull. Soc. Imp. Nat. Mosc. 15: 139, 1842. (*A.*

[1] Accepted April 1972.

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napellus Linn. var. *rotundifolium* Hook. f. & T. Fl. Brit. Ind. 1: 29, 1872). Zanskar (Koelz No. 2912).

Arenaria orbiculata Royle ex Edgew. et Hook. f. Fl. Brit. Ind. 1:240, 1874. Kharbu (Gohil No. 1130).

Bupleurum longicaule Wall. var. **clarke-anum** Wolff in Engl. Pflanzen. Heft 43: 123; 1910; (*B. diversifolium* Clarke in Fl. Brit. Ind. 2:675, 1879). Near Matayan (Gurcharan Singh No. 2786a).

Capsella bursa-pastoris (Linn.) Medic. Pflenzeng. 85, 1792. Leh (Gurcharan Singh No. 2850), Sanku (Gurcharan Singh No. 2742a).

Crepis sancta (Linn.) Babc. ssp. **bifida** (vis.) Thell ex Babc. in Univ. Calif. Publ. Bot. 22: 736, Fig. 236-239, 1947 (*Pterotheca falconeri* Hook. F. Fl. Brit. Ind. 3:399, 1889). Dras (Gohil No. 1110).

Dipsacus mitis Don. Prodr. Fl. Nep. 161, 1825 (*D. inermis* Wall, var. in Roxb. Fl. Ind. ed. Wall. 1:367, 1824). Dras (Gurcharan Singh No. 2690).

Erysimum altaicum C. A. May. in Ledeb. Fl. Alt. III:153. Dras (Gurcharan Singh No. 2690a), (Gohil No. 1064).

Euphorbia kanaorica Boiss. in DC. Prodr. XV, ii, 154, 1862. Bodh Kharbu (Gohil No. 1152), Near Dras (Gohil No. 1230a).

Fagopyrum cymosum Meissn. In Wall. Pl. As. Rar. III:63. Dras (Gurcharan Singh No. 2739).

Geranium tuberaria Camb. in Jacq. Voy. Bot. 33, t. 37, 1841-44. Sanku (Gurcharan Singh No. 2755), Dras (Gohil No. 1240a).

Jaeschkea gentianoides Kurz. in Journ. Asiat. Soc. Pt. II, 230, t. 13, 1870. Matayan (Gohil No. 1174).

Juncus bufonius Linn. Sp. Pl. 328, 1753. Near Matayan (Gohil No. 1166), Dras (Gurcharan Singh No. 3529).

Lactuca lassertiana Clarke Comp. Ind. 270, 1876. Dras (Gammie).

Launea fallax (Jaub. & Spach) Kuntze, Rev. Gen. Pl. 351, 1891. [*L. nudicaulis* Hook. f. (Non Less.) Fl. Brit. Ind. 3:416, 1889]. Bodh Kharbu (Gohil No. 1046), near Sanku (Gurcharan Singh No. 2789).

Leontopodium leontopodinum (DC.P Hand.-Mazz. in Beih. bot. Centralbl. XLIV, II:93, 1927 (*Antennaria leontopodinum* DC.).

Lepidium pinnatifidum Ledeb. Fl. Ross. I: 206, 1841. Bodh Kharbu (Gurcharan Singh No. 2781a).

L. sativum Linn. Sp. Pl. 644, 1753. In Sanku fields (Gurcharan Singh No. 2642b).

Lespedeza juncea Pers. Encl. II: 318, 1807. Kharbu (Gohil No. 1245).

Morina coulteriana Royle III. Bot. Himal. 245, 1835. Zojila pass (Gurcharan Singh No. 2658).

Nepeta connata Royle ex Benth. in Hook. Bot. Misc. III:378, 1833. Near Dras (Gohil No. 1321), Near Matayan (Gurcharan Singh No. 2750b).

Pedicularis pyramidata Royle ex Benth. Scroph. Ind. 52, 1835. Dras (Gohil No. 1209).

P. punctata Dcne. in Jacq. Voy. dans I'Inde Bot. 117, Pl. 122, 1844. Dras (Gurcharan Singh No. 2738), near Daphne (Gurcharan Singh No. 2765).

Pleurogyna spathulata A. Kerner in Ber. Naturw. ver. Innsbruck, I:104, 1870. (Koelz No. 2356).

Polygonum plebejum R. Br. Prodr. 420. Near Umba (Gurcharan Singh No. 2833).

P. polycnemoides Jaub. & Spach, Illustr. II:30, t. 120. Zanskar (Koelz No. 2993).

Prunella vulgaris Linn. Sp. Pl. 600, 1753. Near Matayan (Gohil No. 1299), Dras (Gurcharan Singh No. 2671).

Saussurea roylei Clarke Comp. Ind. 229, 1876. Zanskar (Koelz No. 2916).

Schulzia dissecta (C. B. Clarke) C. Norman in Journ. Bot. Lond. 76:231, 1939. (*Trachydium dissectum* C. B. Clarke in Fl. Brit. Ind. II:672, 1879). Leh (Gohil No. 1274).

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Sium latijugum Clarke in Fl. Brit. Ind. II: 683, 1879. Dras (Gurcharan Singh No. 2761a).

Stachys sericea Wall. Pl. As. Rar. 1:64, 1830. Matayan (Gohil No. 1160), Dras (Gurcharan Singh No. 2675).

Stellaria monosperma Buch.-Ham. ex Don. Prodr. Fl. Nep. 215, 1825, (*S. crispata* Wall. ex Edgew. et Hook. f. Fl. Brit. Ind. 1:229, 1874). Zojila Pass (Gurcharan Singh No. 2690b).

Swertia purpurea Royle III. Bot. Himal. 277, 1839. Zojila Pass (R. R. Stewart No. 21257).

S. thomsonii Clarke in Fl. Brit. Ind. IV: 129, 1883. Dras to Matayan (R. R. Stewart No. 21174).

Taraxacum azizii Von Soest. Near Dras (Gohil No. 1029), Dras (Gurcharan Singh No. 2741a).

T. bicolor DC. Prodr. VII:148, 1838. Near Dras (Gohil No. 1029), Dras (Gurcharan Singh No. 2741a).

T. dealbatum H.-Hm. Mud (Koelz No. 2355).

Trifolium repens Linn. Sp. Pl.:768, 1853. Dras (Gurcharan Singh No. 2780a), near Sanku (Gurcharan Singh No. 2741a).

Valeriana hardwickii Wall. in Roxb. Fl. Ind. Ed. Carey 2:166, 1824. Zojila pass (Gurcharan Singh No. 2655), near Meena marg (Gohil No. 1273).

V. officinalis Linn. Sp. Pl. 31, 1753. Bodh Kharbu (Gurcharan Singh No. 2748a).

Veronica lanosa Royle ex Benth. Scroph. Ind. 45, 1835. Dras (Gohil No. 1211).

V. salina Schur Enum. Pl. Trans. 492, 1866. Near Umba (Gurcharan Singh No. 3220), Dras (Gurcharan Singh No. 2725a).

Vicia hirsuta (L.) Gray Syst. Arrang. Brit. Pl. II:614, 1821. Sanku fields (Gurcharan Singh No. 2725).

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A Catalogue of the Birds in the Collection of the Bombay Natural History Society – 20

Laniidae, Oriolidae, Dicruridae, Artamidae

HUMAYUN ABDULALI

[*Continued from Vol. 73*(2):355]

940 specimens of 63 species and subspecies up to No. 983 in INDIAN HANDBOOK and registered No. 23203 are covered by this part.

933 **Lanius excubitor lahtora** (Sykes) (Dukhun) Indian Grey Shrike **2:** 285

20: 8♂♂ 10♀♀ 2?

1 Rawalpindi, 1 Shikohpur, Jullunder, 1 Ambala, 1 Taxila, 1 Multan, 1 Jajjah Abbesian, Bahawalpur, Punjab; 2 Delhi; 1 Jodhpur; 1 Jakhan, 1 Chadva, 1 Kharirohar, 1 Kutch; 1 Deesa, Palanpur, 1 Radhanpur, 1 Dabka, Baroda, Gujarat; 1 Ratlam, 1 Saugor, C.P.; 1 Nasik, Maharashtra; 1 Cawnpore, U.P.

The shoulders are all black with no grey lesser wing-coverts. ♀ 17004 from Rawalpindi has a slight wash of grey on all the white parts, but otherwise agrees with *lahtora*.

There is some variation in the shades of grey on the upperparts but this appears to be individual. ♀ 4418 from Shikohpur, Jullunder, collected as far back as 1898 is the palest.

Measurements on p. 509.

934 **Lanius excubitor pallidirostris** Cassin (Eritrea) Baluchistan Grey Shrike **2:** 287

3: 1♂ 2 o?

1 *Shaiba, Mesopotamia;* 1 Harboi, 1 Devankot 5000′, Baluchistan.

Wing 111, 112(2) (IH 105-112); bill 16.7, 17.8; tail 102(2), 105, (IH 104-116).

935 **Lanius excubitor aucheri** Bonaparte (Persia) Persian Grey Shrike **2:** 288

16: 5♂♂ 7♀♀ 4 o? (1 juv.)

2 *R. Tanhat,* 2 *Muscat, Arabia;* 1 *Baghdad, Iraq;* 1 *Sanowah,* 1 *Mishun,* 3 *Tanb Is., Persian Gulf;* 1 *Rotak, nr. Sib,* 1 *Barpun, Persian Baluchistan;* 1 Isfandak 33 m. west of Kalat, 1 near Korak and 1 Gajjar Mashkki, 150 and 165 m. s.w. of Kalat, Baluchistan; 1 Bahawalpur Town environs, Punjab.

Measurements on p. 509.

Specimen 4436 from Isfandak has grey on the shoulders and a little black on the forehead. Nos. 4427 and 20758 from Mishun and Tanb Is. in Persian Gulf collected on 13 May and 30 March are immature birds which have pale bills as in *pallidirostris* and very pale upperparts washed with pale fulvous.

936 **Lanius excubitor homeyeri** Cabanis (Sarepta) Turkestan Grey Shrike **2:** 289

nil.

937 **Lanius minor** Gmelin (Italy) Lesser Grey Shrike

10: 3♂♂ 4♀♀ 3?

2 *Sheik Saad,* 1 *Tigris,* 1 *Basra,* 1 *Felujah, R. Euphrates, Iraq;* 1 *Fao,* 1 *Teheran,* 3 *Shiraz, Iran.*

Measurements on p. 509.

All have been collected between 14 April and 20 August. Three specimens obtained in

April, May and August have the black on the head incomplete. Vaurie (1959) and Peters (1960) both accept Fediuschin's *turanicus* which can only be told in the juvenile plumage. ♂ 20755 from Teheran obtained on 11 June had enlarged gonads and was believed to be breeding. Both races, if separable, would appear to be resident or migrants in the area covered by the specimens listed and it would not be possible to decide which race has occurred in Indian limits.

There is much difference in the size of the bills, but it is usually smaller, which with the shorter tail are additional characters for distinguishing this species from *excubitor*.

Specimen 20759 from Felujah has been identified as *L. m. turanicus* by Mr Bond.

938 **Lanius collurioides** Lesson (Pegu) Chestnut-rumped Shrike **2:** 291

6: 5♂♂ 1♀

1 *Shwebo,* 2 *Maymyo,* 1 *Mandalay,* 1 *Tarokman,* 1 *Prome, Burma.*

	Wing	Bill	Tail
♂♂	86-95 av. 90	13-15 av. 14	88-95 av. 91
♀	93	14·5	97
(IH♂♀	85-94	17-19	92-102)

The bill and tail measurements in IND. HANDBOOK quoted from C. B. Ticehurst appear to be in error, and my figures are closer to those in FAUNA, i.e. 13-14 and 86-95 respectively.

There is some difference in the intensity of the chestnut of the upperparts. The single female No. 4638 Mandalay does not have the whitish lores and nasal feathers mentioned in IND. HANDBOOK, while ♂ No. 4634, Tarokman, has a fine white fringe to the black on the forehead.

939 **Lanius vittatus nargianus** Vaurie (Champ, southern Persian Baluchistan) Bay-backed Shrike

2♀♀

1 Panjgur, 26.57 N., 64.7 E., Baluchistan; 1 Chitral Drosh 5000′.

Only two of the several from Baluchistan and northwestern India can be separated as brighter chestnut and paler than the others. The plumage can be matched with immature specimens without black foreheads, e.g. No. 4463 from Cumbum Valley, Kurnool District, Madras.

Wing 89,91; bill 12.2,13.7; tail 84,85

These measurements are no larger than those of the nominate form.

940 **Lanius vittatus vittatus** Valenciennes (Pondicherry) Indian Baybacked Shrike **2:** 289

70: 33♂♂ (2 pull., 5 juv.) 27♀♀ (7 juv.) 10 o? (4 pull. 3 juv.)

1 *Tanb Is., Persian Gulf;* 1 Ghilamambent (?), 21 m. north of Pasni, 1 near Chuttok 95 m. south of Kalat, 1 Kalat, Baluchistan; 3 Chitral; 1 Rawalpindi; 1 Lahore, 1 Nawashar, 2 Shikohpur, Jullunder, 2 Ambala, 1 Harunabad, Bahawalpur; 2 Kotri, Sind, 1 Bajji State, Simla Hills; 5 Delhi; 2 Bharatpur; 2 Kharirohar, 1 Kala Dongar, Pacham I., 1 Chadva, 3 Bhuj, 1 Kutch; 1 Gir, 1 Amreli, 1 Patan, Mehsana, 2 Victoria Park, Bhavnagar, 1 Ajwa, 1 City environs, Baroda, Gujarat; 1 Choral, Indore; 1 *Ghoti, Nasik, 2 Juhu, Salsette, Maharashtra; 1 Hebbankheri, N. Kanara; 1 Kuruvenitho, 1 Aramboli, Travancore; 2 Kurambapatti, 2 Gingee, S. Arcot, 1 Palkonda Hills, 3 Seshachalam, S. Cuddappah, 8 Cumbum Valley, Kurnool; 2 Sankrametta, Vizagapatam Hills, 3 Ramgarh Band, Orissa; 2 Meerut, U.P. (* missing).

The adults of both sexes are said to be similar but most of the males (and only one female) show a distinctive pure white patch after the black of the forehead. Those without it are probably not fully grown, while the female may be an exception or wrongly sexed.

The pullets are heavily barred, with No. 21200 from Bhavnagar showing a very grey head. The juveniles are in varying plumages in which the differences in the colour of the

tail, the upperback, the crown, and the extent and distribution of the barring do not appear to develop or change in the same sequence.

The bird from Tanb Is., Persian Gulf (which would appear to extend the recorded range of this species) is in juvenile plumage and cannot be separated from others in the same phase from India. Similar remarks apply to others from Baluchistan, and *nargianus*, if tenable, is resident beyond these limits.

	Wing	Bill	Tail
♂♂	82-92 av. 86	11·6-14·3 av. 13·2	80-94 av. 85.3
♀♀	84-91 av. 86·7	11·5-14 av. 12·8	76-89 av.84.4

Specimen 4456, a female from Seshachalam has a small white patch on the forehead in front of the black.

941 **Lanius collurio collurio** Linnaeus (Sweden) Redbacked Shrike **2:** 296

17: 6♂♂ (1 imm.) 6♀♀ (2 imm.) 5 o? (4 imm.)

1 *Muscat, Arabia;* 2 *Baghdad,* 4 *Felujah, R. Euphrates,* 1 *Tikrit,* 3 *Tigris River,* 1 *Basra, Iraq;* 1 *Kharg I., Persian Gulf;* 1 Bhujia, 1 Anjar, 1 Rapar, 1 Bhadreshwar, Mundra, Kutch.

Second primary longer than fifth. No white spot on wing, grey head and black-and-white tail distinctive. In immature birds, the tail is brown and not black, but the outermost rectrices are margined with white. The adult has the bill black *contra* yellowish or horny in younger birds.

Measurements under 943 on p. 510.

942 **Lanius collurio phoenicuroides** (Schalow) (Tschimkent) Rufous Shrike **2:** 303

13: 5♂♂ (1 by pl., 1 imm.) 5♀♀ (1 imm.) 3o?

1 *R. Tanhat,* 2 *Muscat, Arabia;* 1 *Shaikh Saad,* 2 *Shatt-al-Adhain, Iraq;* 1 *Tanb Is., Persian Gulf;* 1 *Aliabad,* 13 *m. S.E. of Shiraz, Iran;* 1 Murad Khan, Kalat, 1 Pirandar 190 m. ssw. of Kalat, 1 Teghat 107 m. S. of Kalat, 1 Quetta, Baluchistan; 1* Radhanpur, N. Gujarat.

Second primary almost equal to and less than 5 mm shorter than fifth. All-rufous tail. Head and rump rufous with grey back. White wing patch in males, but smaller or absent in females. Two males and one unsexed with black bill and prominent black eye patch. Two immature birds, a ♂ and a ♀ have the head and forehead barred blackish on a rufous background which turns white on the forehead.

* ♂ No. 4768 from Radhanpur (5 January) was marked as *phoenicuroides* ⪆ *isabellinus* by Meinertzhagen. The upper plumage is very like *isabellinus* but the white spot on the wing and the second and fifth primaries agrees with this subspecies. The key to species in IND. HANDBOOK (*5*: 79) errs in requiring that all subspecies of *collurio* lack the white patch.

Measurements under 943 on p. 510.

943 **Lanius collurio isabellinus** Hemprich & Ehrenberg (Kunfuda, Arabia) Pale Brown Shrike **2:** 302

35: (a) 28 *isabellinus* and (b) 7 hybrid *isabellinus* ⪆ *phoenicuroides.*

(a) 28: 6♂♂ (1 imm.) 17♀♀ (2 imm.) 5 o? (2 imm.)

1 *Khamisiyan, Iraq;* 2 *Duzdap, Seistan, Iran;* 1 Phuljan, Sind; 1 Ambala; 1 Lal Sohara, 1 Harunabad, 1 Yazman, 2 Town environs, Bahawalpur; 2 Delhi, 1 Bharatpur; 1 Hamavas, Jodhpur; 1* Bhujia, 1 Bhuj, Kutch; 2 Wonk, 1 Saiat, Kaira, 1* Nadiad Town, 1* Dabka, Baroda, Gujarat; 2 Ghoti, 1 Igatpuri, Nasik; 2 Thana, 1 Andheri, 1 Esplanade, Bombay.

Isabellinus shows considerable variation in the colour of the upperparts ranging from a brown very similar to that in *phoenicuroides* through pale rufous to a distinct greyish. The tail is all-rufous with the central pairs slightly browner. There is no white spot in the wing. The second primary is more than 6 mm shorter than the fifth, a consistent character for separating it from *phoenicuroide*s in which it

is equal to, or just longer or shorter, than the fifth. This is however wrongly quoted for *isabellinus* by Ticehurst (*Ibis* 1922, p. 61) and repeated in IND. HANDBOOK (5: 90), where incidentally the tail character for separating *Lanius collurio* from *L. cristatus* is mentioned in the paragraph distinguishing the two subspecies *phoenicuroides* and *isabellinus*.

The 5 marked * tend towards *phoenicuroides* in colour and some are marked *isabellinus* ≷ *phoenicuroides* by Meinertzhagen, and 17044 from Thana (12 Nov. 1948) was named *phoenicuroides* by Bond. They can however, I think, well be included under *isabellinus* and may be young of the year as suggested by the slightly smaller bills and the markings on the breast. Their measurements are included under *isabellinus*.

(b) *Lanius collurio isabellinus* ≷ *phoenicuroides*

7: 4♂♂ 3♀♀

1 *Tanb I., Persian Gulf;* 1 Jammu State, near Madhopur, Gurdaspur, 1 Jagadhri, 1 Ambala, Punjab; 1 Bhinmal, Jodhpur; 1 Nandur-Madhmeshwar, Nasik, Maharashtra; 1 no locality (col. F.J.R. Field 31-ii-1892).

The primaries are as in *isabellinus* but they have distinct white spots on the wings.

♂ 4768 obtained at Nandur-Madhmeshwar, Nasik, Maharashtra (5 Dec. 1942) was identified as *phoenicuroides* by Mr Bond. To me it appears closer to *isabellinus* and I am not extending the currently accepted range of the subspecies until a more distinctive specimen is secured.

Measurements on p. 510.

EL **Lanius collurio tsaidamensis** Stegmann (Tarim Basin, Chinese Turkestan)

3: 2♂♂ 1 o?

1 *Kut,* 1 *Felujah, R. Euphrates, Iraq;* 1 *South Persia.*

These birds are outstandingly different in colour and the identification of two has been confirmed at the Smithsonian Institution. Ticehurst (*Ibis* 1920, p. 610) refers to an adult male obtained at Karachi, on 20 Oct. 1918 with the head and underparts uniformly grey. Could it have been this subspecies?

Measurements under 943 on p. 510.

The bills are yellowish-horny and heavier than in *phoenicuroides*.

944 **Lanius tephronotus lahulensis** Koelz (Kolung, Lahul, Punjab) Ladakh Greybacked Shrike **2:** 297

nil.

945 **Lanius tephronotus tephronotus** (Vigors) (Foothills of the Himalayas near Darjeeling, where breeding birds of Gyantse may be expected to winter) Eastern Tibet Greybacked Shrike **2:** 297

23: 13♂♂ (4* imm.) 5♀♀ (2 imm.) 5 o? (2 imm.)

1* *Gyantse,* 1 *Kharta, S. Tibet;* 1 Bankulwa Morang, 1 Dingla, 1 Bijaypur, 1 Nepal; 2 Kurseong 4750′, 1 Suthra, 1 Darjeeling; 1 Poomong 3500′ 1 Rangpo, 1 Singtam, Teesta Valley, Sikkim; 4 Dibrugarh, 1 Mishung, Abor country, 1 Sadiya, Upper Assam, 1 Roopchena, 1 Dimapur, Manipur; 2 *Upper Burma.*

There is considerable variation in the colour of the upperparts—five of the nine adult males are varying shades of grey, while four have a wash of olive-green. Of the four immatures with barring on the underparts only one is grey. The females show the same difference in the amount of grey above. The specimen from Gyantse (Capt. R. S. Kennedy, I.M.S., October 1909) is immature, the barring of the underparts extending to the rump.

None of the specimens show a white wing spot.

Measurements on p. 509.

There are noticeable differences in size, but as it is not possible to associate any difference

in colour with any size group, they have all been measured together.

946 **Lanius schach erythronotus** (Vigors) (Himalayas, restricted to Lucknow; re-restricted to Simla-Almora dist.) Rufousbacked Shrike **2:** 295

59: 33♂♂ (3 juv.) 20♀♀ (2 juv.) 6 o? (2 fledging)

3 Mastang, 1 Nichar 7000′ (?), 2 Kanain Jaunsar 5000′ (?), Baluchistan; 1 Razmak, Waziristan; 8 Chitral, 1 Ladwa, Karnal, 2 Ambala, 1 Shikarpur, Jullundur, 1 Lal Sohara, Bahawalpur; 1 47 m. from Srinagar, Kashmir; 1 Sissoo, 10000′ Lahul; 5 Simla, 2 Solon, 5000′, Bhagat State, 1 Sairi, Patiala; 2 Delhi; 1 Hamavas L., Pali, Jodhpur; 1 Kutch, 1 Golana, Cambay, Gujarat; 1 Devlali; 2 Borivli, 1 Malad, 1 Andheri, 1 Santa Cruz, 1 Kurla, 2 Trombay, Bombay; 1 Mumbra, Thana; 2 Bhimashankar, Poona; 2 Mahableshwar, 1 Satara, Maharashtra; 1 Mokegadda (T.R. Bell—N. Kanara?); 1 Jog, Sagar, Mysore; 1 Barma, 1 Chota Dongar, Bastar, M.P.; 1 Baghowni, Bihar; 1 Bareilly; 1 Ganai, Almora, 1 Tapoban, Yoshimath, Garhwal, 1 Bhimtal, Kumaon.

A few have no white patch on the wing.

Measurements and remarks under *caniceps* (947) on p. 510.

947 **Lanius schach caniceps** Blyth (Madras) Southern Indian Greybacked Shrike **2:** 296

15: 9♂♂ (1 juv.) 4♀♀ 2 o? (1 juv.)

1 Kharaghoda, 1 Dohad, Gujarat; 1 Dodi, Malwa Plateau; 1 Chikalda, Berar; 1 Poona; 1 Kaulas, Nander district; 1 Mahdi, Satara, Maharashtra; 1 Molem, Goa; 1 Kodaikanal, 1 Shembaganur, Palnis; 1 Wadakancheri, Cochin; 1 Palkonda Hills, S. Cudappah; 1 Paloncha, Hyderabad; 1 Golapalli, Bastar; 1 Bakhruj, Monghyr, Bihar.

The upper back is pale grey (*contra* darker grey in most *erythronotus*) and not tinged with rufous, which is restricted to the rump. While individuals in the field at Poona (*caniceps*) can sometimes be easily distinguished from the migrant *erythronotus* in Bombay, several of the skins marked *caniceps* or *erythronotus* by earlier workers, or so referred to in published works are difficult to place with any degree of confidence. Except in a few instances, I am leaving them unchanged, but they certainly need a more extensive investigation.

The two juveniles from the Palnis obtained in May and July and no doubt of a resident population are more heavily barred and deeper rufous than birds in equivalent plumage from the north.

Measurements on p. 510.

947a **Lanius schach kathiawarensis** Koelz (Jamwala, Junagadh) Kathiawar Shrike

6: 3♂♂ 2♀♀ 1 o?

2 Rudra Mata, 1 Chadwa, 1 Godsar, Bhuj, Kutch; 1 Thana, Bombay, Maharashtra; 1 Simla (?).

See Abdulali, *JBNHS 72*(3):854-855 for note on validity and probable error in label marked "Simla". This subspecies is more distinct from both *erythronotus* and *caniceps* than the latter from each other.

Specimen 20304 obtained at Thana, near Bombay, on 6th February 1960 by A. Brosset, indicates a migratory tendency as in the northern *erythronotus*.

Measurements under 947 on p. 510.

948 **Lanius schach tricolor** Hodgson (Nepal, restricted to Kathmandu) Blackheaded Shrike **2:** 292

24: 10♂♂ 10♀♀ 4 o?

1 Jagadhri, Ambala; 3 Pithorgarh, Almora; 1 Pirandar, 1 Sonaripur, U.P.; 1 Remchea, 1 Bans Bahari, Nepal; 1 Temi, W. Sikkim; 1 Rampur, Bihar, 1 Mandasa, Ganjam, 1 Bensarai, Mahendragiri; 1 Bans, 1 Nilgiri, 2 Barkul, 1 Bhusanpur, Chilka, Orissa; 4 Sankrametta, Vizagapatnam, A.P.; 1 Dibrugarh, Assam; 2 *Upper Burma.*

The black heads appear distinctive and the rufous on the upperparts varies in a manner very similar to that in *erythronotus* and *cani-*

ceps in the west, southernmost birds being the greyest. Three from Temi, Dibrugarh and Upper Burma have almost no grey on the back between the black head and the rufous back. Three from Pithorgarh, Almora (2 in June) and Rampur, Bihar (October) with their heads grey mixed with black, would appear to be young birds acquiring adult black heads, but may be the "hybrids" so frequently associated with the subspecies.

Measurements under 947 on p. 510.

949 **Lanius cristatus cristatus** Linnaeus (Benghala) Brown Shrike **2:** 300

39: 12♂♂ 21♀♀ 6 o?

1 Bharatpur, Rajasthan; 1 Galkund, 1 Chikli, Surat Dangs; 1 Chikalda, Berar; 1 Molem, Goa; 1 Santgal, 1 Karwar, 1 North Kanara; 2 Talguppa, 1 Murgimatta, 1 Hikkeri, 1* Sagar, 1 Bangalore, Mysore; 1 Shembaganur, Palnis; 1 Nemara, Cochin, 1 Pambanar Estate, Peermade, 1 Cape Comorin, Kerala; 3 Pt. Calimere, Tanjore; 1 Kurumbapatti, Salem, 1 Seshachalam, S. Cudappa; 2 Jabalpur, 1 Golupalli, Bastar, M.P.; 1 Ramgarh Bund, 1 Kutri, Daspalla, 1 Barkul (Chilka Lake), Orissa; 1 Baghowni, Darbhanga, Bihar; 1 Sannachura, Nepal; 1 Rinchinpong, W. Sikkim; 1 Darjeeling, Bengal; 1 *Upper Burma,* 1 *Thayetmyo,* 1 *Prome,* 2 *Petye, Henzada, Burma;* 1 South Andamans.

There is considerable variation in the intensity of colour on the upperparts, some being much redder than the others. The extent of barring on the underparts and the intensity of the black eye stripes are puzzling but the material available leaves one no alternative but to list them all together.

Sp. No. 22011, a female obtained on South Andamans on 15 February 1964 was originally identified by me as of the nominate race and confirmed by Biswas. However, P. K. Das of Zoological Survey of India and Dillon Ripley both thought it was an immature *lucionensis* and it was so listed in my Andaman paper (1965). In the course of the present examination, I am again prompted to include it with the nominate form, some of which in all probability pass through the Andaman Islands on their way to peninsular India.

Some of the more puzzling specimens were sent to the Smithsonian for subspecific identification with the intention of settling the identity of some of the others which resembled them, after they were returned. Unfortunately a parcel of 7 skins has been lost in the post. Where their identification adds to the known distribution, it has been mentioned in these notes, but it is possible that some others remain included with the present group.

Measurements on p. 511.

950 **Lanius cristatus lucionensis** Linnaeus (Luzon) Philippine Shrike **2:** 302

10: 4♂♂ 2♀♀ 4 o?

2** Pt. Calimere, Tamil Nadu; 1 Narcondam I.; 1 Mannarghat, 1 Port Blair, 1* Wrightmyo, South Andamans; 1 Car Nicobar, 3 Camorta, Central Nicobars.

INDIAN HANDBOOK (5:100) refers to its occasional or regular occurrence in Sri Lanka and to an old record from Kerala as the only one from peninsular India. Two recently obtained by BNHS Bird Ringing Party at Pt. Calimere, on the southeast coast opposite the northernmost part of Ceylon, appeared to agree with Andaman birds, and their identification as *lucionensis* has been confirmed by Mr Bond. They are probably regular visitors to the east coast, at least to this area.

Measurements under 949 on p. 511.

950a **Lanius cristatus superciliosus** Latham (Java)

1♂* Baghownie, Tirhut, Bihar.

Sp. 4752 obtained by Inglis on 17 November 1907 did not agree with the others avail-

The specimens marked * have been lost in the post when returned by the Smithsonian Institute.

able and was sent to the Smithsonian and identified as of this race, establishing a new record for India.

Vaurie (1959) gives the distribution as "Sokhalin and Hokkaido south to central Hondo. Migrates through Japan and eastern China to winter from southern Yunnan; southern Kwangsi and southern Kwantung (probably), to Hainan, Indo-China, southern Malay Peninsula, Anambas, and Greater and Lesser Sundas eastward to Flores and Sumba."

EL **Lanius cristatus confusus** Stegmann (Kumara, Amurland)

2♂♂* Peking, China.

951 **Lanius senator niloticus** (Bonaparte) (White Nile) Eastern Woodchat Shrike **2:** 299

11: 6♂♂ 2♀♀ 3 o?

2 *R. Tanhat, Arabia;* 1 *Shaiba,* 1 *Sheik Saad,* 1 *Jubail Creek, Basra,* 2 *Felujah, R. Euphrates, Mesopotamia;* 1 *Shiraz, Persia;* 2 *Mishun,* 1 *Bilkarz Plain,* 2000′, *Persian Gulf.*

♂ 4743 and ♀ 4736 from R. Tanhat, Arabia (1 April) and Bilkarz Plain (25 March), Persian Gulf, have their heads a paler chestnut and backs greyer. The ♀ was obtained off 5 eggs on 25 March. The ♂ has an indistinct patch of black on the forehead. Two other ♂♂ 4734 Mishun (1 June) and 20810 Basra (8 Sept.) have still paler heads, with the black forehead absent in the former. None of the four however show any traces of barring, above or below, referred to for juveniles in IND. HANDBOOK etc.:

	Wing	Bill	Tail
♂♂	97-103 av. 100	13·1-15 av. 13·6	74-82 av. 78
♀♀	102(2)	14·4(2)	79,81
	(99-104	14-15	71-83)

EL **Lanius tigrinus** Drapiez (Java)

1♂ *Peking, China* (purchased alive). Wing 87; bill 15.3; tail 70.

EL **Lanius nubicus** Lichtenstein (Nubia) Masked Shrike

12: 4♂♂ 2♀♀ 6 o?

1 *Randha Tanhat, Arabia;* 3 *Basra,* 1 *Sheik Saad,* 1 *Baghdad,* 3 *Felujah, Mesopotamia;* 2 *Tanb Island, Persian Gulf;* 1 *Bagh Rezi,* near *Shiraz, Iran.*

According to Etchecopar (1970), the females are duller above and almost white below. Of the three in this plumage, one is marked a male. Female 20909, Randha Tanhat, Arabia (1 April) has the fourth rectrice from the outside, on one side only, projecting 20 mm beyond the rest of the tail.

	Wing	Bill	Tail
♂♀	85-93 av. 90.6	13·1-14·9 av. 14.2	83-90 av. 86·7

952 **Oriolus oriolus oriolus** (Linnaeus) (Sweden) European Golden Oriole **3:** 5

2: 1♂ 1♀ *Fahama, Baghdad, Iraq.*

The female has a pale grey (or dirty?) chin unlike any other under *kundoo.*

Measurements and remarks under 953.

953 **Oriolus oriolus kundoo** Sykes (Dukhun) Indian Golden Oriole **3:** 6

51: 23♂♂ (1 by pl., 13 adult) 24♀♀ 4 o?

6 Chitral, N.W.F.P.; 1 Lehak Lala, Rawalpindi; 5 Simla, 2 Jabli, Baghat State; 1 Kashmir Valley; 1 Almora; 1 Tuna, Kutch; 1 Radhanpur, 1 Ajwa, Baroda; 1 Bijwar, Vindhyas, Indore; 1 Goregaon, 3 Bandra, 1 Colaba, Bombay; 1 Taloja, Panvel; 1 Panchgani, 1 Satara, Maharashtra; 1 Kumta, 1 Majoli, 1 Gondbala, 1 Kop, Karwar, 1 Jog, N. Kanara; 2 Bangalore; 1 Wynaad, 1 Shembaganur, 1 Thattakad, 1 Rajampura, Panthalam Hills; 1 Pt. Calimere, 1 Seshachalam, 1 Madras, 2 Cumbum Valley, 1 Godavary Delta; 1 Bhopalpatna, 1 Saugor; 1 Narsampeth, Hyderabad; 1 Baghowni, Bihar; 1 Hathiban, Nepal; 1 no data.

Sykes when describing *kundoo* said the sexes were alike but his reference to a black bill leaves no doubt that he was handling juvenile specimens. Even after the bill becomes pale, the male has a subadult plumage in which it is still very similar to the adult female and it is possible that it breeds in this plumage, resulting in pairs in identical plumage being seen nesting together. There is no

* See footnote on page 496.

female in the collection identical with the 13 adult males.

The black behind the eye is indistinct in females and in males not yet in full adult plumage, but the two specimens under the nominate form are appreciably larger and have the second primary distinctly longer than the fifth (Vaurie 1958, *Amer. Mus. Novit.*, 1869, p. 2), which is either smaller or about the same size in *kundoo*.

Measurements on p. 511.

954 **Oriolus chinensis diffusus** Sharpe (India) Eastern Blacknaped Oriole **3:** 7

3: 2♂♂ (1 juv., 1 by pl.) 1♀

1 Gudalur, 3000′, Nilgiris; 1 *Temple of Heaven, Peking*, 1 *Foochow, China*.

All have black napes broader than in *tenuirostris* (No. 955). The ♂ (by plumage) from Foochow is the only bird in 954 and/or 955 which has a pure yellow back. The Nilgiri ♀ (9th February) has a bill stouter than in *tenuirostris*, but not as stout as in the two males from China.

Measurements under 955 on p. 511.

955 **Oriolus chinensis tenuirostris** Blyth (Central India; restricted to Assam) Slender-billed Blacknaped Oriole **3:** 9

7: 4♂♂ (1 juv.) 2♀♀ 1 o?

2 Dimapur Road, Manipur, 1 col. by Stuart Baker = Assam?; 1 *N. Shan States*, 1 *Kama, Thayetmyo*, 1 *Tardemaw*, 1 *Pankkaung, Prome dist., Burma*.

None show the all-yellow upperparts as in the adult male of *diffusus* and the races from the Andaman and Nicobar islands.

Measurements on p. 511.

The measurements of the bills do not show very appreciable difference in length, but those of *tenuirostris* are noticeably more slender. The two females (both from Burma) have their underparts a paler yellow, and the upperparts are also a paler (more yellowish) olive-green.

In the Systematic Checklist appended to Smythies *Birds of Burma* (1953, p. 589) *O. c. invisus* is included as the resident form over most of Burma.

Ripley (1940, *Proc. Biol. Soc. Washington* *53*:79-80) when describing *invisus* from South Annam, states that they are similar to *tenuirostris* from Yunnan but considerably smaller. He measures 5 males from Yunnan, wing 151-159 (154.8) and tail 84-89 (85.9) *contra* wing 141-150 (147.2), tail 75-80.5 (78.5) in Annam birds. The wings of the birds from Yunnan are larger than the available specimens from India and Burma, but the tails of *invisus* are very small. I am leaving our specimens from Burma under *tenuirostris*.

956 **Oriolus chinensis andamanensis** Tytler (South Andaman) Andaman Blacknaped Oriole **3:** 10

6: 5♂♂ (2 juv.) 1♀

1 Guitar I., 1 Long I., 1 Bakultala, Middle Andamans; 2 Wrightmyo, 1 Mannarghat, S. Andamans.

The single ♀ does not have the pure yellow head and back of the three adult males. The two juvenile males with streaked underparts lack the black nape.

Measurements under 957 on p. 511.

957 **Oriolus chinensis macrourus** Blyth (Nicobar Islands, Central Group*) Nicobar Blacknaped Oriole **3:** 10

15: details below

(a) 7: 3♂♂ 2♀♀ 2 o?

6 Car Nicobar; 1 Battye Malve (♀)

(b) 8: 6♂♂ 2♀♀ (juv.)

2 Nancowry, 2 Trinkat, 3 Camorta, Central Nicobars; 1 Pilu Bhabi, Great Nicobar.

As in *andamanensis* the adult female differs

from the male in not having a pure yellow and unsullied back. The size of the bill increases southwards, being noticeably larger in the single male from Great Nicobar. Though Oberholser's *eustictus* from Car Nicobar does not appear separable, Blyth after describing *macrourus* said (1846, *JASB 15*:370) that it was found only in the Central Group; and it may be well to restrict the type locality to this area.

Measurements on p. 511.

IND. HANDBOOK (*5*:108) quotes measurements made by me but those relating to the bill should be read as "from feathers" and not "from skull" as stated.

Juveniles (1 ♀ 1 o?) resemble adult females in colour, but lack the black nape.

958 **Oriolus xanthornus xanthornus** (Linnaeus) (Chandernagore, Bengal) North Indian Blackheaded Oriole **3:** 11

26: 14 ♂ ♂ (3 by pl., 5 juv.) 11 ♀ ♀ (2 by pl., 3 juv.) 1 o? (juv.)

1 Daspalla, 3 Badrama, Bamra, 1 Balasore, 1 Dimiria Band, Orissa; 2 Hazaria, Patharghatta, Bihar; 1 Allahabad, 2 Kumaun, Naini Tal, U.P.; 1 Hitwada, Nepal; 2 Calcutta; 1 Goalpara, 1 Dibrugarh, 1 Sadiya, Assam; 1 *N. Shan States;* 1 *Maymyo,* 1 *Popa, Yengo,* 1 *Lienden,* 1 *Monda village, Thayetmyo* 2 *Sindha, Prome,* 1 *Bassein,* 1 collected by Lightfoot = Burma (?).

Notes and measurements under 959 on p. 512.

958a **Oriolus xanthornus reubeni*** Abdulali (Wrightmyo, South Andamans) Andaman Blackheaded Oriole **3:** 11

2 ♂ ♂ (*Holotype): 1 Bambooflats, 1* Wrightmyo, South Andaman. Wing 132, 134; tail 80, 84.

When describing this form I omitted to refer to the bills being thicker than in Indian and Ceylonese specimens, as is noticeable in the material now available. The name has had to be changed from *andamanensis* [*JBNHS 73*(2):395].

959 **Oriolus xanthornus maderaspatanus** Franklin (Ganges between Calcutta and Benares, and in the Vindhyian Hills etc., restricted to Jubbulpore) South Indian Blackheaded Oriole **3:** 11 (part)

18: 11 ♂ ♂ (3 by pl., 2 juv.) 7 ♀ ♀ (3 juv.)

1 Guna, Gwalior, C.I.; 1 Dediapada, Rajpipla, 2 Laochali, Surat Dangs, Gujarat; 1 Chikalda, Berar; 1 Jabbalpore, 1 Gondia, 1 Bhanupratappur, Kanker, 1 Chota Dongar, Bastar, M.P.; 1 Bhandup, Bombay, 1 Khandalla, 1 South Konkan, 1 Rajapur, Ratnagiri, Maharashtra; 1 Karwar, N. Kanara; 2 Palkonda Hills, S. Cudappah, 1 Chitteri Range, Salem, Madras; 1 no data.

The validity of this form has been questioned. Northern adults, individuals of which are appreciably larger, can be separated from southern birds by the paler yellow of the upper and underparts, and the yellow markings on the outer edges of the inner secondaries and tertiaries being elongated and narrow, rather than round and spot-like, and often forming one large patch instead of two. The type locality of *maderaspatanus* has been restricted to Jubbulpore by Whistler. Birds from Orissa are distinctly of the northern form but very similar to individuals from the Central Provinces and the name can be considered for the southern form only if it were possible to move the type locality to Madras as suggested by the name.

Males are more brightly coloured than the females, the difference being visible in the field. The females have slightly smaller wings, and also have all the tail feathers marked with black *contra* only the two central pairs in the adult males. Two southern birds do not agree in this respect but this may be due to error in sexing. This marking is least, or sometimes absent on the penultimate feathers.

In juvenile or first year birds (which show differences in colour among themselves):

(1) the throats and upper breasts are streak-

ed and the upperparts more deeply sullied than in adult females,

(2) the bills (except in 6534 from Kumaun) as in other orioles, are dark *contra* pale in adults, and

(3) in both sexes, the black is not restricted to the two central pairs of rectrices but extends, though to a smaller degree, on to the others, as in adult females.

The yellow on the forehead varies in extent and is only visible in a few specimens.

Two juvenile males from Calcutta (19th December) have a very distinct greenish wash all over.

Measurements on p. 512.

The average wing measurements of the males are deceptive for the northernmost birds from Nepal, Hazaria, and Kumaun have their wings over 140 mm and those from Orissa and Burma are smaller.

960 **Oriolus xanthornus ceylonensis** Bonaparte (Ceylon) Ceylon Blackheaded Oriole **3:** 12

2 o? 1 Anuradhapur, N.C.P., 1 Ceylon.
Wing 129(2) (IH 123-135); tail 79,80 (IH 75-84)

In both specimens the third pair of tail feathers from the centre is slightly marked with black, the outer ones being all yellow. Such markings occur only in two males under *maderaspatanus* and in another nominate *xanthornus* from Prome dist., Burma.

961 **Oriolus traillii traillii** (Vigors) (Himalayas-Darjeeling) Indian Maroon Oriole **3:** 14

34: 19♂♂ (3 first-year) 12♀♀ (1 juv., 8 first-year) 3 o?

1 Ranibagh, 2050′, 3 Dehra Dun, 2 Kumaon, U.P.; 1 Buxa, 1 Gournara, Jalpaiguri, Bihar; 1 Sevoka, 6 Darjeeling, 4 Kurseong, Bengal; 1 Mortam, Rongni Valley, 1 Kalighora, 500′, Tista Valley, 1 Rinchingpong, W. Sikkim; 1 Bhutan Duars; 1 Barha Pani, 3 Tezu, 1 Dening, Lohit Valley, 1 Margherita, Assam; 2 *N. Kraung, Upper Burma;* 1 *Mt. Victoria, Pokokku Hills;* 2 *Mendon Yoma, Thayetmyo, Burma.*

In IND. HANDBOOK (5:112) it is said that in adult females the upperparts are more or less like the adult male's. The four adult females with black chins do not show any trace of maroon except in the tail, nor the gloss in the black of the head. The young of both sexes are alike and resemble the adult female except for the dark chin of the latter. A single male in another pre-adult plumage has a glossy head, streaked underparts, and a maroon wash on the upper and lower parts. Some males are darker maroon both above and below, showing almost black.

Measurements on p. 512.

The Burmese birds have slightly smaller wings and measure:

2♂♂, 2♀♀, 1 o? Wing 142, 143, 137, 130, 139; bill 30.5, 31, 28.5, 29.4, 32.5; tail 102, 103, 93, 95, 100

Female No. 6548 from N. Kraung, Upper Burma, obtained in July has slight pale edges to the wing coverts presumably representing a juvenile plumage.

962 **Dicrurus adsimilis albirictus** (Hodgson) (Nepal) North Indian Black Drongo **2:** 357

34: (a) 21 adults: 6♂♂ 6♀♀ 9 o? (including 5 Upper Burma)
(b) 11 subadults: 5♂♂ 5♀♀ 1*o? (*Maungpeng, N. Shan States)
(c) 2 juveniles: 1♂ 1 o?

(a) 1 Gujar, 1 Jeboo 147 m. ssw. of Kalat, Baluchistan; 2 Boya, 1 Miranshah, Waziristan; 1 Kooargh, 1 Bula, Koenthal, 1 Simla Hills; 1 Bahawalpur, Punjab; 1 Gir, Gujarat; 1 Barkot, Orissa; 1 Bulandshar, U.P.; 1 Paratpur, 1 Dingla, Nepal; 1 Sarung, Bengal; 1 Saroga(?) 5* *Upper Burma* (* see remarks below).

(b) 1 Bhanri, 132 m. ssw. of Kalat; 1 Ambala, Punjab, 1 Bhinmal, Jodhpur; 1 Pachmari, M.P.; 1 Santa Cruz, Bombay; 3 Barkot, Barma, 1 Barkul, Chilka, Orissa; 1 Ghazipur, U.P., 1 *Maungpeng, N. Shan States* (27 September, "irides very dark red brown").

(c) ♂ 5270 Barha Pani, Shillong, Assam; o? 5277 *N'Krang, Upper Burma* (no rictal spot—see remarks below).

Earlier workers have admitted that the Drongos are not very easy birds to identify but the 70 Black (*adsimilis*) and 75 Grey (*leucophaeus*) have provided more work and difficulty than anticipated.

Even in the adult plumage the two species are not so easily separated as is evidenced by the fact that 12 specimens of *leucophaeus* were found listed under *adsimilis* or *vice versa*.

In both species the sexes differ in size and pass through more than one pre-adult stage.

All *adsimilis* are jet black above and below, but this colour acquires a brownish tinge, most marked in the primaries. Specimens obtained between April and September (9) are generally duller and do not have the same gloss as others between October and March (13). *All*, except the five from Upper Burma and the two juveniles under (c) above, have the white rictal spot.

In *leucophaeus* the two dark (*contra* pale) subspecies, *longicaudatus* and *hopwoodi* are accepted in our limits. Neither has a white rictal spot. In *longicaudatus* the upper plumage has a steel grey gloss and a similarly coloured band runs across the breast with the areas above and below lacking this gloss. In both races the bill is heavier, being longer and broader, and lacks the sharply turned tip of *macrocercus* and *albirictus*, a character visible in all phases of plumage and sometimes an important aid in determining an identification. The wing feathers are darker and less brown than in *adsimilis* in which the under wing-coverts at the base of the primaries are black and form a patch of colour contrasting sharply against the rest of the underwing.

Subadults both in *macrocercus* and *albirictus* have their upper breast black as in the adult, with wide white margins to the feathers of the lower belly and under tail-coverts showing these areas largely white. The upper tail-coverts are similarly tipped white, but less prominently.

Subadult *leucophaeus* have the feathers of the lower belly finely fringed with white, while the under tail-coverts are more prominently marked. The last character is prominent in life and often liable to be hidden in the preparation of the skin. The iris is brown and not red as in the adult.

♂ specimen No. 5262 with a white rictal spot obtained in the Chitteri Range, Salem District, on 16-vi-1929 and bearing collector's No. V 426 is presumably one of the 'nestlings' referred to in the Eastern Ghats Survey (*JBNHS 36*:348). The specimen is too large to be taken in the nest, but Whistler's Ms. notes refer to its having a soft skull. This plumage (dull brown all over, paler below) is described in INDIAN HANDBOOK *5*:118, but an equivalent stage in the Grey Drongo cannot be determined, and two specimens Nos. 5270—Barhapani, Shillong, 15-vii-1908, and N'Krang, Upper Burma, which were listed under *leucophaeus* have their bills nearer to those of this species but no rictal spots. There is a further pre-adult plumage in which both the upper and underparts are washed with a varying amount of grey and/or brown but it is not possible to determine if this is consistent.

The 2 subspecies of *adsimilis*, *albirictus* and *macrocercus* are separated by size alone. Ticehurst (1933, *JBNHS 36*:927-929) stressed the necessity of separating the measurements of adult and first year birds but measured the sexes together. He described first year birds as with "browner less glossy wing feathers" and made no reference to the extensive white on the lower belly, undertail coverts, on the

edge of the wing and on the rump referred to above. Vaurie [1949, *Bull. Amer. Mus. Nat. Hist.* *93*(4):236-238] examined and measured 95 specimens of which only 1 male and 2 females were sexed! Sex for sex and plumage for plumage, the two subspecies show no overlap in size.

Table of measurements on p. 514.

The wing and tail measurements of 5 unsexed birds from Burma agree with those of adult male *albirictus* but their bills are noticeably larger:

Wing 151-158 av. 154; bill 22.4-24.5; from nostril 18.3-21.9 (19.5); tail 167, 169, 173.

In one, the upper mandible is deformed, being twisted over the side of the lower. They are too large for *cathoecus* but agree in lacking the white rictal spot. Cripps (S.F. 7:272) noted that there was no rictal spot in any of many he callected in Fareedpur, East Bengal (now Bangladesh). Ripley (*JBNHS* *50*:512) referred to a female shot in Manipur being by its measurements the Burmese form *cathoecus*. The measurements are not mentioned and the record omitted in subsequent publications.

Koelz (1954, p. 15) described *D. m. tsipi* (type locality Pallasbari, Assam), which he separated from those from Nepal and Punjab, because of a larger bill and added on the following page that this was the character which distinguished this race from its neighbours. It is possible that the large-billed birds without the rictal spot which are obviously larger than Swinhoe's *cathoecus* from China may merit separation.

The measurements of unsexed No. 5274 from Maungpeng, North Shan States in subadult plumage (wing 135; bill 20.1, from nostril 16.2; tail 136) agree with those of female *albirictus* in this phase.

Adult ♂ 5229 from Bulandshar, U.P. (wing 150, tail 170) is dated 23 July and was possibly in its breeding range.

The adults include single specimens taken in Nepal in December and February and the southernmost from the Gir (March) has traces of white on the upper and under tail-coverts. The subadults dated between 16 November and 30 January are mostly from further south than the adults suggesting that their migrations are more extensive.

963 **Dicrurus adsimilis macrocercus** Vieillot (Madras City) South Indian Black Drongo **2:** 237

35: (a) 23 adults: 12 ♂♂ 10 ♀♀ 1 o?
(b) 11 subadults: 5 ♂♂ 4 ♀♀ 2 o?
(c) 1 juvenile: 1 ♂

(a) 1 Hamavas, Jodhpur; 1 Bijwar, Indore; 1 Kharirohar, 1 Chadwa, 1 Bhuj, Kutch; 1 Dalkhania, Amreli, 1 Jambugodha, Gujarat; 1 Vasind, Thana, 1 Vihar, 1 Marol, 1 Khar, Bombay, 1 Pen, Kolaba, Maharashtra; 1 Molem, Goa; 1 Kumta, 2 Karwar, North Kanara; 1 Cape Comorin; 1 Kodur, South Cudappah, 1 Cumbum Valley, 1 Godavary Valley; 1 Antagarh, Bastar, M.P.; 2 Kanpur, U.P.

(b) 1 Bhavnagar, Gujarat; 1 Thana, 2 Andheri, Bombay, 1 Pen, Kolaba; 1 Satara, Maharashtra; 1 Kumta, North Kanara, 1 Kalai, Trichinopoly; 1 Tirthimalai, Salem; 1 Bhopalapatnam, Bastar, 1 Jabalpur, M.P.

(c) 1 Chitteri Range. See remarks under *albirictus* above.

The northern subspecies is accepted as migratory but there is no doubt that *macrocercus* also undertakes some local migration. In *Ibis* 1926, p. 570, Whistler, while dealing with the birds of Kangra District, Punjab, refers to the possibility of the two races occurring in the area, and his inability to say whether those seen in winter and summer (in varying numbers) are of one or both races. We have no *macrocercus* from so far north, but the identification of breeding material from several places is necessary, for it is possible that some of the large specimens from further south of

Bombay (e.g. ♂ 24077 Molem, Goa, wing 148, tail 158, with slight traces of white on rump and under tail and heavy 22.7 mm bill) may be migrant *albirictus*, requiring an adjustment in the range of measurments of the two subspecies.

Measurements under 962 on p. 514.

964 **Dicrurus adsimilis minor** Blyth (Ceylon) Ceylon Black Drongo **2:** 358
nil.

EL **Dicrurus adsimilis thai** Kloss (Koh Lak, s.w. Siam)

1♀ Pankaung, Central Burma. Wing 142; bill 18.8; from nostril 16; tail 155.

♀ No. 5248 from Pankaung has a long tail in keeping with this subspecies. The rump is touched with grey and the under tail-coverts tipped white.

965 **Dicrurus leucophaeus longicaudatus** Hay (Segour Pass, Neilgherries) Indian Grey Drongo **2:** 362

54: 27♂♂ 21♀♀ 6 o?

1 Kupwara Road, 52 m. from Srinagar, 1 Kashmir; 7 Simla, 1 Simla Hills; 1 New Delhi; 1 Mandvi, Kutch, 1 Cambay City, 1 Laochali, Surat, 1 Sarwar, Surat Dangs, Gujarat; 2 Bassein, 1 Kanheri, 1 Vihar Lake, 1 Bandra, Bombay, 2 Khandala; 1 Kihim, Alibag, 1 Rajapur, Ratnagiri, Maharashtra; 1 Molem, Goa; 2 Kanthalli, 1 Kodra, 1 North Kanara; 2 Gomaghatta, 1 Talguppa, 1 Ulavi, Shimoga, 1 Manmane, Sidhapur, 1 Bhadrapur, 1 Ligadhally, Sorab Tal, Mysore; 3 Shembaganur, Palnis; 1 Pirmade, 1 Maraiyur, Kerala; 3 Pt. Calimere, Tanjore; 1 Kurumbapatti, Salem; 1 Bailadilla, Bastar; 1 Gurguria, Simlipal Hills; 1 Peori, Almora, 1 Gupta Kashi, 1 Kaliaghat, Gharwal; 1 Mussoorie, U.P.; 2 Bans Bihari, Nepal; 1 Lamba Thach?

The Grey or Ashy Drongo though described from the Nilgiris is known only as a cold weather visitor to the better-forested parts of India, extending into Ceylon. As in the Black Drongo, *adsimilis*, the differences in size and plumage together with its migrations have left much uncertainty regarding the number of subspecies acceptable within our limits. In 1949, Vaurie [*Bull. Amer. Mus. Nat. Hist.* *93*(4):243] separated *beavani*, type locality Khud Khel, eastern Afghanistan, as slightly larger than *longicaudatus* and migrating into peninsular India in winter. He restricted *longicaudatus* to the southern and eastern parts of peninsular India, accepting A.M.N.H. unsexed specimen No. 61855 in juvenile plumage, obtained at Calicut in August, as evidence of its having bred in that area. Later (1958, *Amer. Mus. Nat. Hist.* 1869, p. 6) he discarded this evidence but failed to give detailed reasons for his decision. Subsequent authors have synonymised this with *longicaudatus.*

The specimens fall into 3 (if not 4) different plumages. Adults show a wide diversity in size, but with our present knowledge of its migrations, it is not possible to localize any groups of this *dark* Ashy Drongo, except for the large-billed population [see (d) under *hopwoodi*, No. 966] in Eastern Madhya Pradesh and Orissa.

Table of measurements on p. 513.
The northern and southern birds show no difference in size.

In addition to the normal measurements of the bill from feathers, the length from, and the width at the nostril is also indicated. Though unorthodox, half the product of the last two measurements roughly representing the surface area of the bill, exhibits more clearly the disparity in size, so visible to the eye, but not evidenced by the other measurements.

966 **Dicrurus leucophaeus hopwoodi** Baker (Dacca) Bengal Dark Ashy Drongo **2:** 361

16: details below.

All are distinguished from *longicaudatus* by their decidedly bulkier (longer and wider) and more strongly hooked bills. Some are slightly

paler. In the absence of topotypes and more material from Assam, it is not possible to determine which group represents *hopwoodi*. Baker said it was the largest and darkest of the eastern forms of *Dicrurus leucophaeus*, but this need not be treated as incompatible with his other statement that *stevensi* (type locality Darjeeling, now synonymised with *hopwoodi*) was "decidedly darker than any of the more eastern forms". The last reference would well appear to be to the several paler french-grey forms found further east, rather than to darker *hopwoodi* from south, as has been assumed by Vaurie (1949).

(a) 4: 3♂♂ (2* juv.) 1 o?

1* Mussoorie, U.P.; 1 Martam, Rongin Valley, Sikkim; 1* Margherita, 1 Dening, Lohit Valley, N.E. Assam.

The juveniles are included on geographical grounds and their heavier bills. An adult from Mussoorie (16 June) has the small bill of *longicaudatus* and is included with them. The two adults are dark above, and with a faint wash of grey below. The sexed male from Dening marked *hopwoodi* by Sálim Ali has a 155 mm wing which is appreciably larger than the size 138-148 in IND HANDBOOK (*5*: 121). Baker measured both sexes together 130-153 av. 146. The unsexed bird from Sikkim is marked *beavani* by Ripley.

It may be worth recalling that Stanford and Mayr (1941, *Ibis*, p. 237) when dealing with the birds of Northern Burma, specifically referred to their specimens being distinctly larger and longer-tailed than a series of typical *hopwoodi* from Assam and Cachar.

(b) 4: 1♂ 1♀ 2* o? (1 subadult)

2 Dibrugarh, East Assam; 2* *N'Krang, Upper Burma.*

The three adults have their underparts greyer and paler than those in (a).

(c) 2: 1♂ (juv.*) 1♀

1* Cherrapunji, Khasia Hills; 1 Kangpokpi, Manipur, Assam.

In the adult female from Manipur (also marked *beavani* by Ripley) the measurements agree with those of the specimens under (a) but the underparts are paler grey approaching the *pale* Ashy Drongos (*mouhoti* and others) from further eastwards. The specimen from Cherrapunji has a heavy bill and agrees well with the juvenile under (a) but is included here as it is geographically closer.

(d) 6: 4♂♂ 2♀♀

1 Lamasinghi, 2 Sankrametta, Vizagapatnam Hills, A.P.; 1 Kontia, 1 Bailadilla (No. 20209), Bastar, M.P.; 1 Kuldiba, Orissa.

Of five adults, the two from Sankrametta (March and April) are duller and less steel-blue above, and paler below, than those from Bastar and Orissa (1st November, 2nd January).

These birds are immediately separable by their heavier bills from *longicaudatus* from further south and west. La Personne in the Eastern Ghats Report (*JBNHS 36*:349) referred to birds in pairs by 17 March and with developed organs at the latter end of April. Specimen No. 23870 from Lamasinghi (originally identified and listed as Black Drongo!) was obtained by me on 30 May 1944. The tail in moult, and the dull brown wash above and below indicate a juvenile plumage. There can be little doubt that a large-billed form different from *longicaudatus* is resident in this area, but it has to be decided whether this is identical with *hopwoodi* or some other subspecies already described. It is possible that some of the specimens under *longicaudatus* with exceptionally heavy bills, e.g. ♀ 20405 Vihar Lake, Bombay and ♂ 24078 from Molem, Goa (3 December) are migrants of this form.

Measurements under 965.

966a **Dicrurus leucophaeus selangensis** Reichenow (Junk Seylon or Phuket) White-checked Grey Drongo

nil.

966b **Dicrurus leucophaeus leucogenis** Walden (Ichang, Hupeh) Pale White-cheeked Drongo **2:** 367

1 ♂ Narcondam Island, Bay of Bengal.

Wing 143; bill 22.8; from and at nostril 18.5 × 9.7 (× ½) = 90; tail 135.

EL **Dicrurus leucophaeus mouhoti** Walden (Angkor, Cambodia) Pale Ashy Drongo

3: 2♂♂ (1* subadult) 1♀

1* *Maymyo;* 1 *Ngaphaw,* 1 *Kandin, Prome, Burma.*

Specimen No. 5270* dated 20 April is darker above and below, and lightly washed with pale brown all-over, most distinct on the head and throat, and appears to be in a subadult plumage, the grey not being as pure as in adults.

The two adults from Prome were examined by Ticehurst (1931 *JBNHS 36*:907) but only recorded as "*D. leucophaeus* Pale Ashy Drongo".

The Bird Gallery of Prince of Wales Museum of Western India exhibits a Grey Drongo which has almost white under tail-coverts, but which may otherwise well be included in this group. The section register shows it as obtained at "Salem, Madras in 1929" which would suggest that it is one of the specimens obtained by the Eastern Ghats Survey which was camped in this district from 8 April to 7 May 1929. The specimen is not referred to in Whistler's report but it is possible that it was mounted and retained for exhibition, and never taxonomically examined. But this would be a most unexpected record of a Burmese bird from Tamil Nadu and only a fresh specimen can warrant its acceptance.

EL **Dicrurus leucophaeus nigriscens** Oates (Kyeipaden, near Pegu, Burma) Burmese Dark Grey Drongo

1 ♂ *Ataran River, Amherst, South Burma.*

Wing 130, bill 23.1; from nostril 19 × 9.6 width at nostril × ½ = 91; tail 127.

This small bird is marked *nigriscens* and was shot off eggs by J. P. Cook on 25 April 1913. It has an ashy brown plumage, very similar to that of subadult *longicaudatus*. It is curious that a dark form should be separated from the other dark subspecies *hopwoodi* by an intervening pale *mouhoti*.

It may be worth keeping in mind that in South Tenasserim Hopwood (*JBNHS 26*: 856) found two nests which he attributed to this species but which were very different in construction and held eggs of different types.

967 **Dicrurus caerulescens caerulescens** (Linnaeus) (Benghala) Whitebellied Drongo **2:** 365

43: 26♂♂ 11♀♀ (2 juv.) 6 o? (3 juv.)

1 Ladwa, Karnal, Punjab; 1 Gwalior, 1 Bijapur, Indore; 1 Cambay City, 1 Balaram, Palanpur, 2 Pandwa, 1 Galkund, Surat Dangs, Gujarat; 1 Raipur, Melghat, 1 Kalyan, Thana, 1 Khandala, Poona, 1 Savantwadi, Ratnagiri, Maharashtra; 3 Molem, Goa; 2 Karwar, 1 North Kanara; 1 Ulavi, Sorab Tal, Mysore; 1 Maraiyur, Travancore; 1 Kurumbapatti, Salem, 1 Palkonda Hills, 1 Seschachalam, South Cudappah, 2 Nallamalai, South Kurnool; 1 Paryal, 2 Jabalpore, 1 Gondia, 2 Bhanupratapur, Kanker, C.P.; 1 Daspulla, 1 Badrama, Barma, 1 Pithabata, 1 Besai, Mayurbhanj, 1 Keongarh, 1 Koira, Bonia, Orissa; 3 Baghowni, Bihar; 1 Pilibhit Terai, U.P.; 2 Tribini, Nepal.

The juvenile has a white belly like the adult, but lacks the gloss on the head and breast which are brownish. The head first acquires a gloss, followed by a grey tinge on breast, which becomes darker in the final phase. This widespread species shows no consistent difference of size or colour but it must be noted that specimens are lacking from over large areas in the north and east and no definite

information is available regarding the nature of the seasonal movements which undoubtedly occur.

Table of measurements on p. 510.

Two males from Nepal have the longest wings (134, 136) and tails (136, 137) and are the only specimens in which the tail is longer than the wing. Some have bills noticeably larger than others, e.g. ♂ 5301 Kalyan, Bombay.

968 **Dicrurus caerulescens insularis** (Sharpe) (Lunugalla, Madodouna, Ceylon) Ceylon Whitebellied Drongo **2:** 365

nil.

969 **Dicrurus caerulescens leucopygialis** Blyth (Colombo, W.P. Ceylon) Ceylon White-vented Drongo **2:** 366

nil.

970 **Dicrurus annectans** (Hodgson) (Nepal) Crowbilled Drongo **2:** 353

4: 3♂♂ (1 juv.) 1 o?

1 Bahraich, Oudh; 3 Dibrugarh, Assam.

Wing 139, 143(2), 152; bill 26.1, 27.9; tail 126(2), mltg. (2)

The juvenile is brownish below with the feathers of the lower breast broadly tipped with white.

971 **Dicrurus aeneus aeneus** Vieillot (Dacca) Bronzed Drongo **2:** 368

44: 20♂♂ (2 juv.) 15♀♀ (4 juv.) 9 o? (1 juv.)

1 Karwar, 2 N. Kanara; 1 Govadsagar, 1 Canacona, Goa; 2 Calicut, 1 Balamore, Ashambo Hills, 1 Maraiyur, Kerala; 1 Sheveroy Hills, 1 Chitteri Range, Tamil Nadu; 1 Lamasinghi, 3 Sankrametta, Vizagapatnam Hills; 2 Kameli, Bailadilla Hills, Bastar; 2 Badrama, Barma, 1 Toda, Bonai, 1 Gurguria, Simlipal Hills, Orissa; 2 Ranibag, U.P.; 1 Martam, Rongi Valley, Sikkim; 4 Dibrugarh, 1 Margherita, 1 Sadiya, 1 Bipani, Dibang Valley, Mishmi Hills, 1 Roopchena, 1 Cherrapunji, 2 Haflong, Assam; 1 Nanyaseik, Chindwin, 2 *N'Krang*, 1 *Upper Burma*, 2 *Leindon*, 1 *Thanichang Res.*, 1 *Kandin*, 1 *Sinde*, *Prome*, *Burma*.

Except for 3 from Ashambo Hills, Sadiya and Mishmi Hills which are almost completely black, the other adults have a varying shade of grey on the underparts, which cannot be divided into darker and/or paler groups.

The juveniles are dull brown below, with the sheen lacking on the head and upperparts in some.

Stuart Baker (*2*:368) refers to young birds being heavily spotted with white on the axillaries and under wing-coverts. All except six (3 juveniles and 3 adults) from widely separated areas show a varying amount of spotting. The juveniles are not included in the measurements.

Measurements on p. 512.

972 **Dicrurus remifer tectirostris** (Hodgson) (Nepal) Lesser Racket-tailed Drongo **2:** 373

8: 5♂♂ 3♀♀

2 Darjeeling, U.P.; 1 Singtam, Teesta Valley, 1 Berrick 600', 1 Martam, Rongni Valley, Sikkim; 2 Margherita, 1 Sadiya, Assam.

Measurements on p. 509.

973 **Dicrurus hottentottus hottentottus** (Linnaeus) (Chandernagore) Haircrested or Spangled Drongo **2:** 370

39: details below.

(A) 12: 5♂♂ 6♀♀ (1 juv.) 1 o?

1 Savantwadi; 1 Valpoi, 1 Canacona, Goa; 1 Kodra, 2 North Kanara; 1 Namadachilume, Tumkar, Mysore; 1 Kuldhiha, Nilgiris, 1 Mahendragiri, 2 Badrama, 1 Berberi, Puri, Orissa.

(B) 10: 6♂♂ 2♀♀ (1 juv.) 2 o? (1* juv.)

1 Kalka, Ambala, 2 Simla; 1 Naini Tal, U.P.; 2 Martam, Rongni Valley, 2 Singtam, Teesta Valley, Sikkim; 1 Kurseong, Bengal; 1* Kutch.

(C) 9: 8♂♂ 1♀ juv.

7 Goalpara, 2 Dibrugarh, Assam

(D) 8: 3♂♂ 4♀♀ 1 o?

1 *Sadan Chaung, Thayetmyo;* 3 *Toungoo;* 1 *N'Mai Village,* 1 *Sandoway;* 1 *Kyibim, Henzada;* 1 *Ataran R., Amherst, Burma.*

There can be little doubt that the Himalayan birds (B) described as *crishna* by Gould (*P.Z.S.*, 1836, p. 5) are distinctly larger than those from peninsular India and Burma and deserve separation. Birds from Burma have their bills slightly thicker than in both Himalayan and peninsular birds but do not have them short enough for *brevirostris* (Cabanis & Heine, China). The type locality of nominate *hottentottus* has been shifted from the Cape of Good Hope to Siam and then to Sikkim and now rests at Chandernagore in Bengal. The birds from Orissa are small but those from Assam and Burma intermediate and may consist of an admixture of large migrants and smaller residents. The unavailability of the type or topotypes has prevented any statement as to whether the nominate form is large or small, and allowing for the known movements of the species, it is not possible to take a decision. I trust that somebody with access to topotypical (Chandernagore) material will settle this problem and permit the acceptance of two subspecies in Indian limits. It would probably be simplest to accept the type locality as Sikkim, synonymise *crishna* therewith and recognise Koelz's *londae* for the smaller southern birds.

The bill measurements in INDIAN HANDBOOK quoted from Vaurie (1949) are said to be "from skull" but are actually from "the anterior border of the nostril" (loc. cit., pp. 207 and 280). Juveniles have no glossy feathers on the breast. The spangles in young birds are small and spot-like *contra* large and elongated in adults.

Table of measurements on p. 512.

The specimen from Kalka, Ambala, was collected by A. E. Jones on 13 December 1919 and is marked "Hornets in gizzard."

974 **Dicrurus andamanensis dicruriformis** (Hume) Great Cocos and Table I.) Large Andaman Drongo **2:** 372

nil.

975 **Dicrurus andamanensis andamanensis** Tytler (Port Blair, Andaman Island) Small Andaman Drongo **2:** 371

6: 4♂♂ (1 subad.) 2♀♀ (1 subad.)

Measurements on p. 509.

I have already (*JBNHS 61*:550) referred to measurements of these specimens.

The species resembles *D. hottentottus* in the hair on the forehead, the upturned ends of the outermost tail feathers, the white spotting on the under wing-coverts and the traces of the spangling as specks visible on the breast of the largest male (No. 22026).

976 **Dicrurus paradiseus grandis** (Gould) (Nepalia) Northern Large Racket-tailed Drongo **2:** 378

28: details below.

INDIAN HANDBOOK (*5*:136-137) includes the birds from Orissa and Central India with the large-crested birds from Nepal and Assam. Though they agree more closely with the northern birds, this intermediate population was accepted as *rangoonensis* (Gould) by Vaurie (1949) and are now separately listed, as also the few from Burma.

(a) 12: 5♂♂ 4♀♀ 3 o?

2 Hazaria, Patharghatta, Bihar; 1 Salukapur, 2 Ranibag, Kurseong, 1 Kumaon, U.P.; 1 Sukna, Darjeeling; 1 Goalpara, 1 Margherita, 1 Tezu, 1 Denning, Lohit Valley, 1 Garo Hills, Assam.

These are true *grandis* with large crests.

(b) 11: 8♂♂ 3♀♀

1 Juna, Rajpipla, Gujarat; 1 Narsampeth, Pakhal Lake, Warangal, A.P.; 2 Gondia, 2 Bhampratappur, Kanker, 1 Antagiri, 1 Bhopalapatnam, Bastar, C.P.; 1 Bhusandpur, Chilka Lake, 2 Badrama, Barma, Orissa.

(c) 5: 3♂♂ 1♀ 1 o?

1 *Pwaydone*, 2 *Lower Chindwin*, 1 *Bassein*, 1 *Ataran, Burma.*

Measurements on p. 515.

977 **Dicrurus paradiseus paradiseus** (Linnaeus) (Siam, restricted to the region between Ayuthia and the head of the Gulf) Southern Large Racket-tailed Drongo **2:** 377

14: 4♂♂ 4♀♀ 6 o?

1 Laochali, Surat Dangs; 1 Jogeshwari, Bombay; 2 Vengurla, Ratnagiri; 2 Molem, Goa; 2 Karwar, 1 Castle Rock, 1 Jog, Sagar, 1 Bhadrapur, Sorab, Karnataka; 1 Shevaroy Hills, 1 Wynaad, 1 Tenmalai, Kerala.

Measurements on p. 515.

Most of both sexes have a varying amount of white spotting on the under wing-coverts.

978 **Dicrurus paradiseus ceylonicus** Vaurie (NE Province, Ceylon) Ceylon Large Racket-tailed Drongo

nil.

979 **Dicrurus paradiseus lophorhinus** Vieillot (Africa, restricted to Ceylon) Ceylon Crested Black Drongo **2:** 373

nil.

980 **Dicrurus paradiseus otiosus** (Richmond) (Andamans) Andaman Racket-tailed Drongo

5: 3♂♂ 2♀♀

2 Long Island, Middle Andamans; 1 Wrightmyo, 2 Port Blair, South Andamans.

In one male the crest is as distinct as in *nicobariensis,* but this subspecies is slightly larger than *nicobariensis* from Great Nicobar (see *JBNHS 64*:178). The two females have the under wing-coverts more distinctly spotted with white than the males.

Measurements on p. 515.

981 **Dicrurus paradiseus nicobariensis** (Stuart Baker) (Kondel, Nicobars) Nicobar Racket-tailed Drongo **2:** 380

4: 2♂♂ 2♀♀ Great Nicobar.

As in 1980, the females are slightly smaller than the males.

Measurements on p. 515.

982 **Artamus fuscus** Vieillot (Bengal) Ashy Swallow Shrike **2:** 348

30: 17♂♂ (1 imm.) 12♀♀ 1 o?

1 Solon, 5000′ Simla; 1 Goregaon, Bombay, 2 Vengurla, Ratnagiri; 1 N. Kanara; 2 Perumalmalai, Palnis 5000′, 2 Jamestown, Kanyakumari, 1 Maraiyur, 3500′, Kerala; 1 Shevaroy Hills, 1 near Madras; 1 Buchireddipalam, Kavur, Nellore, A.P.; 1 Koira (Bonai), 1 Badrama, Barma, Orissa; 1 Bhutan, near Aie River; 1 Seooke, Teesta Valley, 1 Denton, Sikkim; 1 Dibrugarh, 2 Margherita, 1 Roopchena, 1 Cachar, 1 Hungrum, 1 Guilang, N. Cachar, Assam; 1 *Akyab,* 1 *Tarokmaw, Prome district;* 1 *Inbin,* 1 *Yebank,* 1 *Henzada, Burma.*

There is a very small difference in size between the sexes, and northern birds from Simla, Orissa, and eastwards, are slightly larger than those from the south.

Measurements on p. 515.

Two of the specimens Nos. 5214 ♂ Inbin, Henzada district, 27 December 1930, and 17219 ♀ Seooke, Teesta Valley, Sikkim, 1 February 1944, are marked as "V. fat".

Immature No. 5209, a ♂ from Dibrugarh, dated 19 July 1901, has pale edges to the tips of the primaries and coverts, and the head is brownish like the back, rather than grey.

There is some variation in the extent of grey on the head and back as also the extent of the greyish or brownish wash on the underparts, but it is not possible to group them by sex, season or locality. Two from Jamestown, Kanyakumari, which are the most recent specimens, appear greyer than the others.

983 **Artamus leucorhynchus humei** Stresemann (Andamans) Whitebreasted Swallow Shrike **2:** 350

6: 4♂♂ 2*♀♀ * missing

5 Wrightmyo, S. Andamans; 1* Bakultala, Middle Andamans.

Measurements on p. 509.

The difference between the grey of the head and the colour of the back is greatly exaggerated in fig. 8, Plate 5, in INDIAN HANDBOOK (Vol. 5, facing p. 32).

Measurements

933 Lanius excubitor lahtora

	Wing	Bill	Tail
♂♂	110-115 av. 112.7	17-19.1 av. 18	107-123 av. 114·4
(IH	108-115	from skull 20-26	106-122)
♀♀	106-120 av. 110·8	16·5-18·9 av. 17·6	100-125 av. 110·5
(IH	105-113	from skull 19-25	107-118)

935 Lanius excubitor aucheri

	Wing	Bill	Tail
♂♂	113,114,118	17·5-20.1 av. 18·6	109-113 av. 109·8
♀♀	109-112 av.110·6	16·7-18.6 av. 17·8	104-113 av. 107.8
(IH ♂♀	107-116	—	c. 106--118 *ex* Hartert)

937 Lanius minor

	Wing	Bill	Tail
♂♂	117,117,118	13·6,16.9,17 & broken	87,90, –
♀♀	117,118,121,126	15·1,16·7(2),17·3	88(2), 92,94
(IH ♂♀ *ex* Hartert	115-123	Females - usually somewhat smaller	85-95)

945 Lanius tephronotus tephronotus

	Wing	Bill	Tail
♂♂	96-107 av. 102	15·7-18·5 av. 17·1	96-113 av. 106·5
♀♀	95-108 av. 101	16·2-17.9 av. 16·8	94-109 av. 103

972 Dicrurus remifer tectirostris

	Wing	Bill	Tail
♂♂	136-148 av. 140·4	21·3-24 (23)	349,441, 446
(IH *ex* Vaurie	137-149	from skull 25-30	402–532)
♀♀	134,138,139	23,23,23·6	321,366,402
(IH *ex* Vaurie	133-146	for skull 24-28	354-466)

975 Dicrurus andamanensis andamanensis

	Wing	Bill	Outermost Tail
♂♂	135,136,142	27·4,28·5,29	166,166,-
♀	133	27·2	158

983 Artamus leucorhynchus humei

	Wing	Bill	Tail
♂♂	132-133	18·2-19·2	52-58 av. 56
♀	128	18·5	56

943 **Lanius collurio isabellinus** and other subspecies

	Wing	Bill	Tail
♂♂ *L. c. collurio*	92-96 av. 94·2	14·2-15.6 av. 14·7	70-78 av. 74·4
♂♀ *L. c. collurio*	91-96 av. 93·8	13.6-15·6 av. 14·1	70-81 av. 74·4
(♂♀ Witherby	87-98	12-14	FAUNA 74-80)
♂♂ *phoenicuroides*	91-93 av. 92·2	13·8-15·3 av. 15	77-80 av. 78·4
(IH ♂♂	91-97	from skull 17-20	78-85)
♀♀ *phoenicuroides*	93-95 av. 94	13·1-15·5 av. 14·5	75-79 av. 77·5
(IH ♀♀	90-94	from skull 17-20	78-83)
♂♂ *isabellinus*	89-99 av. 92	14·7-15.5 av. 15·2	77-84 av. 80
(9 ♂♂ Paludan	89-94 av. 91	– –	76-84 av. 79·2)
♀♀ *isabellinus*	89-94 av. 90·7	13·8-15.5 av. 14·7	75-82 av. 78·2
(4 ♀♀ Paludan	86-95	– –	70-81)
♂♀ hybrids 942 x 943 ?	91-98 av. 93	15-15·7 av. 15·3	79-85 av. 82
♂♂ *tsaidamensis*	95,96	13·4,14·7	80,84

947 **Lanius schach caniceps** and other subspecies

	Wing	Bill	Tail
erythronotus ♂♂	88-98 av. 93·3	14.8-17·7 av. 16	95-122 av. 112·5
(IH	88-98	from skull 19-23	107-127)
caniceps ♂♂	90-95 av. 92	15-16·8 av. 15.6	103-118 av. 111·5
(IH	90-98	from skull 19-22	113-127)
kathiawarensis ♂♂	86,89,94	16.5 (3)	105,112, mltg.
tricolor ♂♂	91-98 av. 93·7	15·7-17·6 av. 16·5	96-122 av. 110·5
(IH	93-101	from skull 20-23	115-135)
erythronotus ♀♀	89-98 av. 92·8	15.2-17·2 av. 16·2	102-115 av. 106·8
(IH	87-95	from skull 19-23	107-119)
caniceps ♀♀	86-93 av. 89.5	15-16·3 av. 15·7	99-120 av. 107
(IH	87-95	from skull 19-22	100-118)
kathiawarensis ♀♀	87,88	16(2)	95,99
tricolor ♀♀	87-94 av. 91	15·8-17·7 av. 16.7	100-121 av. 111
(IH	92-96	from skull 20-23	106-126)

967 **Dicrurus caerulescens caerulescens**

	Wing	Bill	from nostril	at nostril	Tail
♂♂ (25)	121-136 av. 128	19·2-22·5 av. 21·6	16-20·1(17·1)	8·2-10·3 (8.9)	110-137 (121)
(IH	122-137	from skull 22-25	—	–	112-130)
♀♀ (8)	120-128 av. 124	19·4-21·7 av. 20·4	15·7-17·1 (16·6)	8-10 (9)	115-127 (120)
(IH	118-129	from skull 22-25,27	—	–	113-130)

949/950 **Lanius cristatus cristatus** and **L.c. lucionensis**

	Wing	Bill	Tail
cristatus ♂♂	85-89 av. 86·6	15·5-17·8 av. 16	81–89 av. 83·5
(IH	85-89	from skull 18-20	78-86)
♀♀	84-91 av. 87·1	14·4-17·2 av. 16·2	76-85 av. 80·6
(IH	80-89	from skull 18-20	78-89)
lucionensis ♂♀	83-93 av. 88.5	15·1-17·5 av. 16	80-90 av. 85
(IH	87-92	*c.* 15	77-89)

952/3 **Oriolus oriolus oriolus** and **O.o. kundoo**

	Wing	Bill	Tail
nominate ♂♀	156,153	25,26	86,81
(IH ♂♂	150-161		
♀♀	146-157 - *ex* Witherby)		
kundoo ♂♂ ad. (15)	136-146 av. 141	26·7-30·6 av. 27·8	82-90 av. 86·5
kundoo ♂♂ subad. (7)	137-142 av. 139	27.5-30·3 av. 28	84-90 av. 86·3
kundoo ♂♀ juv. (4)	133,138,139,146	23.8,26·7,28·2,-	81,82,87,91
(IH ♂♂	135-147	from skull 29-33	86-94)
kundoo ♀♀ ad. and subad. (9)	136-146 av. 141	25·3-29 av. 27·3	84-90 av. 86·8
kundoo ♀♀ juv. (15)	133-149 av. 138·6	25·9-29·7 av. 28	81-91 av. 86·3
(IH ♀♀	133-143	from skull 29-33	81-92)

954/5. **Oriolus chinensis diffusus** and **O.c. tenuirostris**

	Wing	Bill	Tail
diffusus ♂, juv. ♂, ♀	mltg., 148,152	31,30·3,29·8	88,91,93
(♂♀	147-155	28-31	89-95)
tenuirostris, ♂♀	143-150 av. 147	28·9-31.8 av. 30.8	83-91 av. 85.4
(♂♀	142-155	30-33	more or less as in *diffusus*)

956/7 **Oriolus chinensis andamanensis** and **O.c. macrourus**

	Wing	Bill	Tail
andamanensis ♂♂	136,139,140	29·5,30·2,30·7	95,97,97
Car Nicobar ♂♂	154, 154, 157	30·4(2),33·4	112,115,118
Central Nicobar ♂♂ (5)	153-158 av. 154·6	33·8-35 av. 34.5	106-114 av. 110
andamanensis ♀	133	29·8	mltg.
Car Nicobar ♀	150	32·7	114
Battye Malve ♀	152	32.4	113
Camorta ♀	154	32·5	117
Great Nicobar ♂	158	36.7	118

959 **Oriolus xanthornus maderaspatanus**

	Wing	Bill	Tail
nom. ♂♂	134-147 av. 139	26.7-30 (28·2)	74-91 (86)
(IH ♂♂	135-151		86-100)
nom. juv. ♂♂	129-137 av. 128		79-89 (81·4)
nom. ♀♀	129-140 av. 134.3	26·4-29 (28·1)	80–84 (83)
(IH ♀♀	137, 139		92,93)
maderaspatanus ♂♂	134-145 av. 140	28·5-30 (29·3)	89-91 (85)
(IH ♂♂	131-140	from skull 27-32	82-87)
maderaspatanus ♀♀	132, 135, 136	25·1-29·5 (27·8)	81,83,84,85
(IH ♀♀	130-138	from skull 28-31	83-88)

961 **Oriolus traillii traillii**

	Wing	Bill	Tail
ad. ♂♂	143-152 av. 147·4	28-33·8 av. 31	102-112 av. 106
1st year ♂♂	144,145, –	30·5,30·6,31·5	100,102,107
(IH	141-153	from skull 31-35	99-110)
ad. ♀♀	143,145,147,149	28,28.6,30·7,-	102,105 (2), 110
1st year ♀♀	135-148 av. 142	28·7-32·2 av. 30.2	98-109 av. 103·2
(IH	140-146	from skull 29-33	100-112)

971 **Dicrurus aeneus aeneus**

	Wing	Bill	from nostril	at nostril	Tail
♂♂	117-126 av. 121·6	18·1-20 av. 19·2	14·2-16·1(15·3)	7·3-9·4 (8·1)	95-120 (112)
(IH *ex* Vaurie	112-131	from skull 20-25	–	–	105-131)
♀♀	116-130 av. 121	17·8-20	14·1-16·1(14.9)	7·8-8·4 (8·1)	101-121 (112)
(IH *ex* Vaurie	112-127	from skull 21-25	–	–	105-124)

973 **Dicrurus hottentottus hottentottus**

	Wing	Bill	from nostril	Central Tail	Outermost
A ♂♂ (5)	155-170 av. 164	33·7-36·7 av. 35	27·3-29·2 av. 28·6	118-134 av. 124	126-142 av. 134
A ♀♀ (5)	152-167 av. 157	34·6-35·8 av. 35·3	27·8-29·1 av. 28·5	120-134 av. 124	125-143 av. 131·5
B ♂♂ (6)	163-181 av. 169	37·6-39·2 av. 38·6	31·5-34·7 av. 32	120-134 av. 126	132-150 av. 140
B ♀ (1)	172	38	30·2	130	143
C ♂♂ (8)	167-176 av. 170·5	35-38·9 av. 36·7	28·2-32·5 av. 30·1	116-136 av. 123	136-150 av. 142
D ♂♂ (3)	163,164, 167	33·7,36·3,38·6	28·5.30·3 (2)	121,127,132	134,138,–
D ♀♀ (4)	156,168,169,170	34·5,35,36·2,38·5	28·4,29·3,29·4,29·5	120,125,129,130	130,141,142,150

965 D. leucophaeus longicaudatus

Adults

	Wing	W/T%	Bill	from nortril	Width at nostril	"Area"	Tail
16 ♂♂	132-147 av. 139·2	89	21·5-24·8 av. 22·5	17·5-19·5 av. 18·56	8·1-9·4 av. 8·68	73-85 av. 80.4	140-178 (156)
5 north	139-142 av. 140.5		21·5-23·6 av. 22.5	17·8-19·6 av. 18·75	8·1-9·1 av. 8·58	73-85 av. 80·3	140-178
11 south	132-147 av. 138.7		21·5-24·8 av. 22·5	17·6-19·5 av. 18·48	8·5-9·4 av. 8.72	74·3-85 av. 80·4	
8♀♀	121-143 av. 136	90	21·4-24·7 av. 22·7	17·7-19·8 av. 18·5	8·2-9·1 av. 8·45	73-90 av. 78·5	132-165 (152)
4 north	139-143 av. 141		21·6-24·7 av. 23·1	18·5-19·8 av. 19	8·3-9·1 av. 8·6	77-90 av. 82	155,165,180
4 south	121,131,135		21·4-23.1 av. 22·3	17·7-18·2 av, 18	8·2-8·6 av. 8·3	73-78 av. 75	126-150 (138)

Slightly duller below, but no white

	Wing	W/T%	Bill	from nortril	Width at nostril	"Area"	Tail
4 ♂♂	137-145 av. 141·5	90	22·2-23.1 av. 22·6	18·6-20·1 av. 19·1	7·9-9·4 av. 8·6	75-88 (81)	148-164 av.157·5
3 north	139,145,145	89	22·2,22·6,22·7	18·6,18·9,20·1	8·6,9·4	80-88	154,164,164
1 south	137	92	23·1	19	7·9	75	148
5♀♀	133-139 av. 136	90·6	21·7-23·8 av. 22·6	16·8-19.6 av. 18·4	7·5-8·2 av. 7·7	63-76 av.70·5	135-158 (150)
3 north	133,136,139		21·7,22·1,23·8	16·8,18·2,18·8	7·5,7·5,7·6	63,68,68·5	151,154,158
2 south	136,138		22.7,23	18·7,19·6	8,8·2	76,78	135,152

Greyish below with white fringes to feathers

	Wing	W/T%	Bill	from nortril	Width at nostril	"Area"	Tail
9 ♂♀	127-139 av. 134	93·7	21·2-23·8 av. 22·6	17·5-19 av. 18·3	7·6-9·8 av. 8·4	66-89 av. 73	130-148(143)
4 ♂♂	130-139		21·2-23·8	17·6-19	7·6-9-1	67·5-86·5	135-155
3 ♀♀	130-138		22·5-23·2	18·2-18·9	8·4-9·8	79·5-89	142-148

Juv. = brownish grey below

	Wing	W/T%	Bill	from nortril	Width at nostril	"Area"	Tail
9♂♀	133-141 av. 136·4	93·4	21·2-23·7	17·7-19·3 av. 18·2	8·5-9·2 av, 8·7	78-82 av. 79·5	132-160 (146)
3 ♂♂	135-141		22·3-23·7	17·7-18·7	8·5,9·1, 9·2	76,80,82	140-155
5 ♀♀	133-139		21.2-23·2	17·9-19.3	8.5-8·8 av. 8·6	78-82 av. 80	132-160

966 D. leucophaeus hopwoodi

	Wing	Bill	from nostril	Width at nostril	"Area" (a x b) x ½	Tail
(a) 1 ♂ 1 o?	155,146	23·9,25·4	19·5,21·3	10·3,10·1	100·4,107·5	167,152
(b) 1 ♂ 1 ♀ 1 o?	146, 144,147	24·7,24·7,24	19·4,19·9,-	9,9,9·5	87,89·5	162,154,155
(c) 1 ♀	145	24·6	20.5	9·5	97·5	156
(d) ♂♂ (6*)	136-148 av. 142	22·8-24·4 (23·6)	18·8-20·1 (19·4)	9·4-10 (9·8)	98-98 (95)	153-157
♀♀ (4*)	138-146 av. 141	23·5-25·4	19.3-20	9·2-10	90-97	147-157

* These include measurements of 2♂♂ and 2♀♀ obtained in Simlipal Hills, Orissa, in February 1951 and in the collections of Zoological Survey of India.

Dicrurus adsimilis subspecies

Adults

	Wing	Wing/tail %	Bill	Bill from nostril	Tail
albirictus ♂♂ (6)	149-160 av. 153·8	87-91 av. 89	18·7-22·3 (20·7)	16-18·5 (17)	167-182 (173)
(IH	153-156	–	from skull 25-28	–	159–172)
macrocercus ♂♂ (12)	134-148 av. 142	94-100 av. 96	18·7-22·7 (20·3)	15·3-17·3 (16·4)	140-158 (149·5)
(IH	130-147	–	from skull 23-26	–	134-168)
albirictus ♀♀ (6)	144-146 av. 145	93·5-97 av. 94.6	19·6-21 (20·4)	16·3-17·2 (16·6)	149-158 (154)
(IH	149-153	–	from skull 26	–	159-166)
macrocercus ♀♀ (10)	134-142 av. 138·4	94-98·6 av. 95·7	19·3-21·5 (20·2)	15·1-17·2 (16)	139-147 (143.7)
(IH	130-147	–	from skull 23-26	–	134-168)
Subadults					
albirictus ♂♂ (5)	138-143 av. 139·8	92·6-101·5 (96·4)	19-22·3 av. 21	16·1-17·9 (17)	136-150 av. 145·2
macrocercus ♂♂ (5)	132-134 av. 132.8	102·3-103·8 (103.2)	19·2-21·7 av. 20	15·5-17·5 (16·2)	127-130 av. 128.8
albirictus ♀♀ (5)	131,137-145 av. 138	95.6-104·5 (98·7)	18·8-21·2 av. 20·3	15·1-16·8 (16·1)	133-146 av. 139·4
macrocercus ♀♀ (3)	130,132,133	97.7,99·2, 100	19·4,19·5,20·2	15·2-16·9 (15·9)	130,134,135

In male *albirictus* the tail is proportionately longer, making the wing/tail ratio an unreliable character for separating it from the *Dark* Ashy Drongos in the field.

Dicrurus paradiseus subspecies

Males

		Wing	Bill	from nostril	Tail	Central tail	Crest
976 *grandis*	(5)	163-182 av. 174	31-35 av. 33	24·8-28 av. 26·8	298-415 av. 370	150-165 av. 155	44-72·5 av. 54
	(Vaurie 1949	175-185 av. 181·25	–	25-29 av. 27·43	447-578 av. 498	145-162 av. 157·33	54-66 av. 58.33)
976 (a) ,,	(8)	158-171 av. 164	30-34 av. 32	25-27·5 av. 26·2	300-402 av. 342	141-150 av. 145	29-65·5 av. 44
	(Vaurie 1949	163-172.5 av. 167·57	–	–	-	138-156 av. 146·25	31-55 av. 42·5)
Burma	(3)	161,163,165	30·4,30·5 (2)	26·4 (2), 27	310,355,370	150 (2), 155	42,43,47
977 *paradiseus*	(4)	153-161 av. 156	28·2-29+ av. 28·8	23-24.3 av. 23.4	360,480	130,131,140,141	15,18,20,25
(IH		151-170	from skull 33-37		295-484	133-142	–)
980 *otiosus*		157,159,163	30,31,33	–	324,325,335	139,150,159	–
(♂ ♀		152-167 av. 162	29-34 av. 32	up to 450	–	–)	
981 *nicobariensis*		153,158	30·8,–	–	290,347	132,140	–

Females

		Wing	Bill	from nostril	Tail	Central tail	Crest
976 *grandis*		168,171,175,179	33,35,36,37·5	28-28·5	350,365,370,510	145,150,157,165	56,58,60,66
	(Vaurie 1949	165-181 av. 170·35	–	25-28 av. 27	362-458 av. 396·45	142-155 av. 149·1	46-70 av. 53·4)
976 (a) ”		160,165,167	29·5,32,33	24,25,26·5	267,353,384	137,145,154	37,42·5,50
Burma		160	33	28	-	140	34
977 *paradiseus*		149,151,153,156	28·5,30,30,30·5 (2)	22,22·5,24(2)	310,345 (2), 357	130 (3), 150	22·5-24·5
(IH		148-154	from skull 33-36	–	310-358	128-136)	
980 *otiosus*		155,156	31, –	–	340,340	139,140	–
981 *nicobariensis*		147,152	31,32	–	315,316	129,134	–

982 **Artamus fuscus**

	Wing	Bill	Tail
Northern ♂♂ (8)	130-143 av. 135·5	18·5-19·7 av. 19	53-58 av. 55·6
Southern ♂♂ (8)	130-137 av. 132	18·5-20·7 av. 19·5	53-58 av. 55·6
Northern ♀♀ (7)	130-141 av. 135	17·3-19·7 av. 18·3	52-58 av. 53·7
Southern ♀♀ (4)	128-134 av. 130·7	18·2-18·5 av. 18·3	51-57 av. 54

(to be continued)

Miscellaneous Notes

1. OCCURRENCE OF INDIAN PIPISTRELLE, *PIPISTRELLUS COROMANDRA* (GRAY) [MAMMALIA: CHIROPTERA: VESPERTILIONIDAE] IN CAR NICOBAR, ANDAMAN AND NICOBAR ISLANDS

During a faunistic survey of the Andanman and Nicobar group of islands in 1972, a dead male specimen of pipistrelle was collected from the base of a coconut tree near the sea coast in Car Nicobar. On examination it was found to be an example of the Indian Pipistrelle, *Pipistrellus coromandra* (Gray).

According to literature (Dobson 1876; Blanford 1888; Ellerman & Morrison-Scott 1951), *P. coromandra* is known from the Indian mainland, Ceylon, Burma, southern China and Indochina. Hill (1967), in his paper on bats of the Andaman and Nicobar islands, did not mention this species. It would, therefore, appear that this is the first authentic record of *P. coromandra* from these islands. Besides, this extends its range much further southward. However, the subspecific identification was not possible due to lack of more specimens.

The details of the specimen are given below. External measurements were taken from preserved specimen.

Pipistrellus coromandra (Gray)

1838. *Scotophilus coromandra* Gray, *Mag. Zool. Bot.* *2*:498 (Pondichery, Coromandel Coast, India).

Material: 1♂: Malaca, Car Nicobar (20 Feb. 1972).

Measurements: External: Head and body 46.0; tail 22.9; fore-arm 31.7; ear 10.2; tibia 11.2; foot and claw 7.1.

Cranial: Upper tooth-row 4.7; mandibular length 9.1.

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ZOOLOGICAL SURVEY OF INDIA,
8, LINDSAY STREET,
CALCUTTA, 700 016,
October 30, 1975.

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2. STATUS OF THE NILGIRI LANGUR *PRESBYTIS JOHNI* (FISCHER) IN THE NILGIRIS

I had the opportunity of going through the paper of G. U. Kurup (1975) about the "Status of the Nilgiri Langur, *Presbytis johni* in the Anamalai, Cardamom and Nilgiri hills of the Western Ghats, India. Probably he was not able to correctly determine the status of this langur in the Nilgiris. During my last 15 months' stay in the Nilgiris about 8 months I spent searching for the Black-and-Orange Flycatcher (Ecology and behaviour of this bird is my present subject of study) among the sholas. Most of the time I was walking along and amongst the sholas located between 4500 and 8000 feet above mean sea level. Casual trips have been made to cover areas up to 2500 feet that is Gudalur, Mudumalai, Masinagudi, and other areas. Recently I visited the Periyar Wildlife Sanctuary, Kumuli, Peermade and a part of Cardamom and Kannan Devan hills of Kerala. I have also covered Bandipur and Nagarhole Wildlife Sanctuaries and Brahmagiri Hills of Karnataka. The Nilgiri Langur seemed to be more common in the Nilgiris than any other spots I have so far covered in the Western Ghats.

Within about 5 km of Ootacamund town, the most populated and advanced hill station of South India there are at least 4 troops of this langur. Two troops are present in the Governor's and Andy's corner sholas and two along Ooty-Kotagiri bus route. Altogether I have seen 3 troops along above route, 5 or 6 troops between Schoolmund and Pykara, and 4 or 5 troops between T. R. Bazar and Naduvattum all along the ghat section of the Mysore road. The sholas around Upper Bhavani, Mullumund and Avalanche, Sispara Pass, Bangitappal, Koru Kundah, Nilgiri Peak, Mukurti Peak, Mukurti, Chinna Mukurti, etc., also support a good number of troops which were heard and a few seen by Mr. E. R. C. Davidar, Mr. R. Sugathan, and myself. Mr. Davidar is a naturalist of the Nilgiris and is currently trying to determine the status of the Nilgiri Tahr, while Mr. Sugathan is studying the Blackwinged Kite in these hills. They are also of the opinion that it is fairly common in the Nilgiris around the heights indicated above.

The presence of the Nilgiri Langur around 2000 m (Kurup 1975) may be explained in the following ways.

(1) In the Nilgiris the sholas from 5000 ft up to the highest summit (Doddabetta *c.* 8600 ft) are completely devoid of the Common Langur *Presbytis entellus* (Dufresne), and Bonnet Macaque, *Macaca radiata* (Geoffroy) is to be seen occasionally. Whereas these two species are common below 5000 ft that is in Segur Range, Mudumalai, Bandipur and Nagarhole Wildlife Sanctuaries. It is likely that the Nilgiri Langur avoids competition by selecting typical sholas here.

(2) There is a continuity of distribution of the Nilgiri Langur in Attapadi forests of Kerala and Mukurti and other sholas of Western plateau of the Nilgiris. This langur can be seen in Mukurti area. At the same time they could be heard in the Silent Valley some thousand feet down. That is its habitat is more or less continuous here, whereas the Pykara range abruptly ends in Masinagudi area of Segur range leaving grass-covered hills in between.

(3) It seems that more people with valid permits go for shooting small game in Segur and Masinagudi areas than in the typical sholas. Sound of fire-arms usually terrifies the

langurs. Probably the Common Langur is more tolerant to all these. More people and cattle visit deciduous forests than sholas around 6000 ft.

(4) Like the Common Langur, if undisturbed, the Nilgiri Langur probably does not mind residing around homesteads within the vicinity of the sholas, e.g. Pykara, Schoolmund, Naduvattum, Avalanche, and Andy's Corner troops. Prater (1971) has rightly said that they (Nilgiri Langurs) are not confined to forest and may invade gardens and cultivated woodland. They live at levels ranging from 3000 up to 7000 feet.

(5) Food material is abundant in the sholas throughout the whole year than in the deciduous forests. In the former, the Nilgiri Langur can feed on young leaves and tender shoots which are present throughout the year. Moreover this langur loves eating fruits and buds of *Acacia melanoxylon* usually cultivated and run wild around 6000 feet.

(6) Kurup (1971) said that by and large the distribution in the general range (in Anamalai) was found to be rather patchy, with preferred pockets even in seemingly contiguous, suitable areas. The same also holds good for its distribution in the Nilgiris.

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I am grateful to Ms. E. R. C. Davidar and R. Sugathan for providing additional information.

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3. A SURVEY OF BITES AND OTHER INJURIES INFLICTED BY RHESUS MACAQUE *MACACA MULATTA* ON MAN IN MAROTH VILLAGE (RAJASTHAN, INDIA)

(*With a text-figure*)

INTRODUCTION

The Rhesus Macaque, *Macaca mulatta* (Zimmermann), the common macaque of northern India is found in forests as well as near human habitations. It is pugnacious by nature and has a tendency to bite when handled in the laboratory and in field (Singh 1969; Valerio *et al.* 1969; and others). But no surveys of such bites or other injuries inflicted by it in the natural state on human beings appear to have been made.

From 1968 to 1971 I carried out a survey of bites and nail scratches in a small free-living population in and around Maroth village *c.* 27°15′N., 75°15′E., Nagaur district, Rajasthan.

In December 1971, the free-living Rhesus

Macaque population in and around Maroth village, including the surrounding hills and cultivated fields, was about 72 individuals grouped into two bisexual troops. They roost at night in deserted houses in the village, and during the day wander about in the hills as well as invade houses and cultivated fields for food.

Two methods of survey were followed, namely, by interviewing persons and by the examination of hospital records. By interviewing people 90 cases of actual 'bites' were recorded directly from the bitten persons or from their guardians. The healed scars of 'bites' and nail scratches too were examined in several cases. Hospital records (15 cases) of 'bites' were available in the Government Hospital at Maroth alone for the year 1971. Cases duplicated in the hospital and in the interview records were treated as of hospital records. In this way a total of 105 'bite' cases were recorded (15 from the hospital and 90 through interviews). These 90 interview cases were grouped into three categories on the basis of age-groups of the victims: 1-10 years (25); 11-20 years (38) and 21 years and above (27). The sexes of the victims were also recorded where available (see Table).

Results

Of the 90 victims analysed who received 104 wounds, 61 'bites' (59%) were on the hands, 20 (19%) on the legs, and the remaining 23 (22%) on other parts of the body.

Table

Macaca mulatta. 'Bites' (including other injuries, e.g. nail scratches) on human beings at Maroth village (Rajasthan, India), for the years 1968-1971 (including one in 1958), based on interviews of victims and other persons

Age-group of victims	Sex and number of victims		Circumstances of bites (and their number)					
			While snatching food by monkey	While chasing monkey	Monkey attacked to protect her infant	During monkey fights	Other circumstances	Total number of bite (including cases of double bites)
1-10 years	♂ 13	25	4	3	1	1	4	26 (25+1 double bite)
	♀ 12		7	0	0	1	5	
11-20 years	♂ 22	38	8	10	0	1	4	40 (38+2 double bites)
	♀ 16		8	1	1	1	6	
21 years and above	♂ 7	27	3	3	0	1	0	28 (27+ 1 double bite)
	♀ 20		13	1	2	0	5	
TOTAL	♂ 42 ♀ 48	90	43	18	4	5	24	94 (90+4 double bites)

The nature of the wounds varied from simple scratches (evidently made by nails) to larger wounds inflicted by the canines. The latter varied from linear to curved cuts (about 10-55 mm long); rounded or irregularly shaped canine marks (size roughly 5 × 10 mm), some

single and others double; and larger wounds, one of them being as large as about 20 × 37 mm at the surface. Most of the wounds appeared to have been caused by the large canines of males and a few by the incisors and smaller canines of females.

Seasonal frequency of 'bites'

The bites inflicted were least frequent from January to May and in September and October, and most frequent from June to August and in November and December (Fig. 1). This seasonal difference may be because of the fact that from June to August, and again in November and December many females are with young and are probably more aggressive. According to Prakash (1958, 1962) there are two birth seasons in Jaipur (which is not far from Maroth village), the first in late March to early April and the second from end of September to early October.

Most of the 'bites' were inflicted when the monkeys were prevented from pilfering foodstuff from houses, and in a few cases when the mother monkey felt that her infant was threatened. 'Bites' were inflicted as a rule by individual monkey only. Four cases of attack by groups were recorded but fuller details were not available.

Up to about 20 years of age there is no

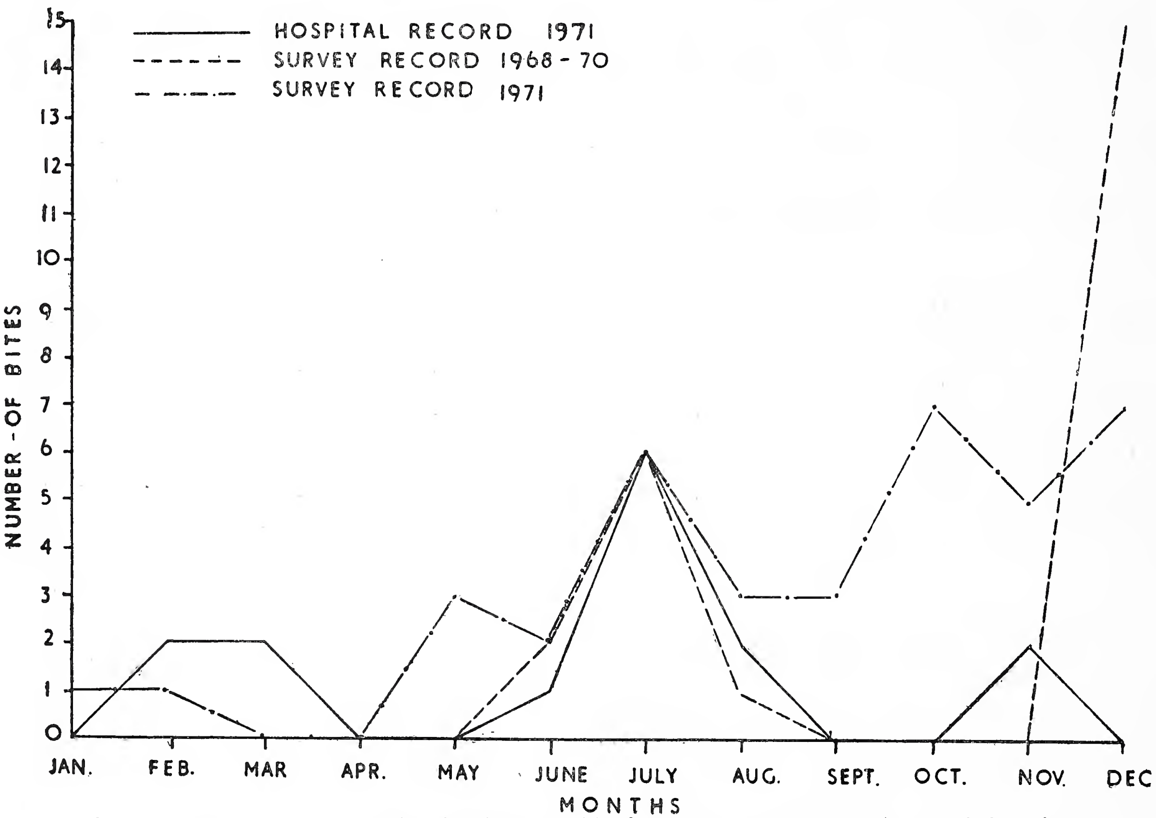

Fig. 1. *Macaca mulatta.* Graphs showing monthly frequency of 'bites' on human beings in Maroth village during the years 1968-1971.

appreciable difference in the proportion of assaults on male and female victims, but the circumstances of bites seem to differ. Children (1-10 years) had practically an equal chance of being bitten irrespective of sex. Even in the age-group of 11-20 years there is no appreciable difference between assaults on different sexes, although the reasons for this lack of difference are probably different. Thus, on males of this age-group most of the 'bites' were inflicted either while chasing away the monkeys or while preventing them from snatching food, and on females mainly for the latter reason since girls of this age-group do not usually take part in chasing the monkeys and also because they are as a rule in the kitchen, either cooking food or helping their mothers. In the third age-group (21 years and above) interestingly the majority of victims (about 75%) are females. This is perhaps because most of the time it is the women who stay in the house (which monkeys invade so often), and the male members being generally away.

Most of the victims were bitten only once, but three were bitten twice and one thrice.

ACKNOWLEDGEMENTS

This paper is a small portion of the study on the ecology and behaviour of the Rhesus Macaque, which is being carried out by me under the supervision of Dr M. L. Roonwal to whom I am indebted for guidance. Thanks are also due to Professor S. D. Misra for providing working facilities, to Dr N. K. Soni for permission for examining the records at the Government Hospital at Maroth, and to Dr S. M. Mohnot for assistance in various ways.

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4. NOTES ON A YOUNG HYBRID MACAQUE
(*With a photograph*)

A female Assamese Macaque (*Macaca assamensis*) living with a group of five Stumptailed Macaques of both sexes and one male Pigtailed Macaque preferred to escape into an adjacent enclosure occupied by one adult male and one young female Bonnet Macaque (*Macaca radiata*) in March 1974 at Nandankanan Biological Park, Orissa. Several attempts were made to separate her from the Bonnet Macaques without success.

A male hybrid macaque young was born to this female Assamese Macaque and the male Bonnet Macaque on 9-iii-1975. The hybrid baby was born completely covered with hair and with its eyes open. In the crown hair of the head, the shape of the ears and the length and shape of the tail it resembled the father. The colour of the body coat resembled that of the mother.

There appears to be no record of such a hybrid in the available literature (Gray, A. P., 1972; MAMMALIAN HYBRIDS Commonwealth Agricultural Bureaux, Farnham Royal, Slough, England).

We are thankful to Shri P. K. Patnaik, Bhubaneswar for the photograph.

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Photo. 1. The Assamese Macaque (*Macaca assamensis*) mother with her six weeks old hybrid baby.

5. LONGEVITY OF TWO SPECIES OF INDIAN MONGOOSES IN CAPTIVITY

The present report embodies observations on the longevity of two species of Indian mongoose in captivity at Nandankanan Biological Park, Orissa.

SMALL INDIAN MONGOOSE (*Herpestes auropunctatus*). A full-grown adult male of this species received in the Park on 5-ii-1967 died on 27-ix-1975, i.e. after 8 years, 7 months and 23 days in captivity. The estimated age at the time of death was about 9 years and 8 months. This was housed in a small enclosure having a cemented floor space of approximately 3.25 sq. metres and with provisions of a wooden sleeping box and a water trough. It was kept

either alone or with common mongooses and maintained very good health on a mixed diet of fish, snail-flesh and banana.

CRABEATING MONGOOSE (*Herpestes urva*). An adult male of this species received in the Park on 24-i-1965 died on 11-i-1975, i.e. after 9 years, 11 months and 19 days. The estimated age at the time of death was about 12 years. It was living in an enclosure having a cemented floor space of approximately 5.25 sq. metres and was provided with a wooden sleeping box and a water trough. It was kept with two females of the same species from 1971 onwards. As already reported by Acharjyo & Misra (1972) it maintained excellent health on a diet of fish and snails.

Prater (1971) states that the smaller species of mongooses like the Small Indian Mongoose live from seven to eight years, whilst the larger forms like the big Stripednecked Mongoose, may have a life span of 13 years and more. The life span of the genus *Herpestes* is given as 7 to 12½ years (Walker *et al.* 1964). Longevity records of these two species are not given by Crandall (1965). According to Blanford (1888-91) fruit is sometimes included in the diet of the Indian Mongoose, but this could not be supported by Crandall (loc. cit.).

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6. SOME RIDDLES OF GAME BIRD MIGRATION IN KUTCH - 2

It is almost two decades, since I wrote the first note (*J. Bombay nat. Hist. Soc.* *54*:466-468; 1957). This instalment gives some further information on other migratory birds. Of the three, namely Imperial Grouse [*Pterocles orientalis* (Linn.)], Waku Grouse [*Pterocles senegallus* (Linn.)] and duck dealt with in my first article, the position has not changed except that I have noticed a large collection of duck this year in Banni where there are vast

areas under rain water; but in inland tanks very few birds are to be seen.

The other four migratory birds I am now writing about, are the Houbara [*Chlamydotis undulata macqueenii* (Gray)], the Florican [*Sypheotides indica* (Miller)], Comb Duck [*Sarkidiornis melanotos melanotos* (Pennant)] and Lesser Flamingo [*Phoeniconaias minor* (Geoffrey)]. While I have noticed over many years that the numbers of the Houbara have been dwindling from year to year, this year shows a very sharp decrease, so much so that I fear this species is on the verge of extinction. Houbaras are regular winter visitors to Kutch and a normal bag of 6 to 12 in a day's shoot was considered quite normal; and anything from 20 to 50 birds were seen in a day's hunt. This year in all the areas favoured by these birds (which covers over 300 sq. miles) not more than 12 to 15 birds have been seen. In a normal year one expects to see about 100 to 150 birds over this area.

The migration of the Forican no doubt depends on the rainfall, since they come to Kutch in the rainy season. When the rains are good and timely, they come in good numbers and breed here. 30 to 40 birds can be seen in a day. This year, in spite of good rains and suitable conditions practically no bird was observed! Both these birds are apparently well on the way to extinction! At any rate they are not coming to Kutch as they did before.

On the other hand both Comb Duck and Lesser Flamingo seem to have done well. Both breed in Kutch, when conditions are favourable. I saw quite a few birds (with half grown chicks puddling in the creek near Pacham Island—just near India Bridge; I did not see any flamingo of the larger variety. The Lesser are easily distinguished from their larger cousins by being so very pink. The half grown chicks are greyish black, with no trace of pink. They were quite at a distance and I could not say whether the half grown birds could fly. But I think not.

The Comb Duck seem to have bred all over Kutch this year. In practically all the tanks including small tanks near the villages, I saw chicks—quite small and unable to fly—with the parent birds all around Bhuj and in the Lakhpat district.

Of course the local game such as the Grey Partridge, Black Partridge, Hare and Chinkara are persecuted mercilessly, and sold in the market. Today's true sportsmen in Kutch have to content themselves with reading the records of what was once available for sport, in this country, described by Dr Sálim Ali as 'Sportsman's Paradise' in the book he wrote in 1945 on BIRDS OF KUTCH. If the local and residential game is not given protection, they will disappear and therefore, the implementation of game laws is essential, before it is too late!

As it is, four migratory birds have stopped coming: Imperial Sandgrouse and Greylag Geese completely and the Houbara with the Florican almost. It will be interesting to find out whether the numbers of these birds has also been affected in the neighbouring territories such as Rajasthan and Saurashtra.

PALACE,
BHUJ, KUTCH,
February 1, 1976.

H. H. MADANSINHJI OF KUTCH

7. COMMUNAL ROOSTING IN THE MYNAH *ACRIDOTHERES TRISTIS*

Sengupta (1973) concluded that communal roosting in the Common Myna, *Acridotheres tristis* (L.) had evolved primarily as an anti-predator adaptation. He considered that communal roosting was of no advantage with respect to food location in this species because the birds he studied fed either individually (in towns) or in small parties (in country areas), rather than in large flocks, although he found that Mynas did flock when food became locally abundant. This range of feeding dispersion patterns is found in many omnivorous species, and is related to the kind of food that is available at any moment. Thus Cattle Egrets *Bubulcus ibis* feeding on insects or chasing seabirds to make them regurgitate their last meal do so singly or in small parties, but when food becomes locally abundant, e.g. at refuse dumps, they feed in loose flocks (Feare 1975). Similarly Rooks *Corvus frugilegus* feed in large dense flocks in the winter while feeding on grain, but feed in smaller, widely dispersed groups when they feed on soil invertebrates in the summer. Patterson *et al.* (1971) thought that this wider dispersion within small groups reduced interference between individual birds feeding on invertebrates that could take avoiding action. Even in the summer, however, Rooks roosted communally, and when unpredictable local abundances of food did appear large numbers of birds quickly assembled there (Feare *et al.* 1974). Furthermore, it seemed likely that communal roosting helped birds to discover these local abundances when they did occur, and Feare *ea al.* (1974) obtained circumstantial evidence that large winter roosts helped birds to find food in unfamiliar feeding grounds when their usual feeding areas were rendered unavailable due to unpredictable falls of snow. Ward & Zahavi (1973) stressed that large communal roosts may exist even when all members of the roost are adequately fed, but could act as an insurance against any unpredictable food shortage affecting part of the population. Solitary feeding in birds that roost communally, and which will feed in flocks if suitable food is available, need not therefore negate the hypothesis that communal roosting has evolved as a method of disseminating information about food distribution. Both Ward & Zahavi (1973) and Feare *et al.* (1974) regarded this as the main function of communal roosts, but noted that these assemblages of birds could attract predators, and therefore required protected positions for the inactive period and anti-predator behaviour while the birds were assembling.

In 1972-73 I made observations on Mynas in the Seychelles which suggest that the food location hypothesis does apply to roosts of this species. Mynas were introduced to the Seychelles, probably in the early nineteenth century (Gaymer *et al.* 1969) and have become successful colonisers of many of the islands. On Mahé, the largest island of the group, Mynas are common except in the highest forest. In lowland areas they fed singly and in small parties in plantations and other fairly open habitats, but assembled in larger flocks at refuse tips and on ripe fruit trees where they caused damage. In secondary forest on higher ground they appeared to be mainly furgivorous, and fed in flocks on the ripe fruits of guavas *Psidium* sp., mangoes *Mangifera indica,* Santol *Sandoricum indicum,* bois rouge *Dillenia ferruginea,* etc. although they also fed in smaller groups in open grass-

land, in tea plantations and occasionally on breadfruit *Artocarpus altilis* and jackfruit *A. heterophyllus* which had been crushed on roads. In these situations their food was loalised in both space and time, and on Mahé communal roosts were conspicuous by their noise both in the towns and villages and in the mountains. Potential predators at these roosts included rats *Rattus rattus,* Barn Owls *Tyto alba* and occasional migrant falcons.

On Bird Island, on the other hand, no communal roost of Mynas was found during a total of 10 months residence on the 70 ha. island, most of this period being out of the birds breeding season (Feare in prep.). Although no estimate of the population was obtained, there were probably well over 100 birds on the island. Apparently suitable trees (e.g. *Ficus* sp., *Cordia subcordata, Guettarda speciosa*) were present, though not widespread. Rats were abundant but very recently introduced (1967), and both Barn Owls and migrant falcons occasionally visited Bird Island. The main difference between the two islands in terms of Myna ecology appeared to lie in the distribution of food, which on Bird Island appeared to consist mainly of insects (and possibly seeds) and ripe pawpaws *Carica papaya.* The insects were obtained from open areas within the coconut plantation, and from treeless areas such as the airstrip, and also the Sooty Tern *Sterna fuscata* colony once this was vacated by the terns. Pawpaw trees were also widely distributed within the coconut plantation, and there were no localised concentrations of ripe fruit. The only time that a flock of 10-20 Mynas was seen when I put out large quantities of rice to attract Madagascar Fodies *Foudia madagascariensis* —the fodies, which did roost communally, rapidly discovered the rice and a large flock formed, but the assembly of Mynas was slower, and they appeared to be attracted by the fodies.

These observations on Mynas in the Seychelles thus support the hypothesis that communal roosting is related to food distribution in this species. The solitary feeding frequently seen by Sengupta (1973) and myself is most likely related to the type of food available at the time, but the birds continue to roost communally as this helps them to utilize the local abundances of food that periodically occur. The apparent absence of communal roosting on Bird Island is remarkable since Fryer (1910) did not mention the Myna in a list of species that occurred there, and it has presumably reached Bird Island very recently.

The observations in the Seychelles were made possible by a Natural Environment Research Council grant to Prof. G. M. Dunnet, which enabled me to hold a Research Fellowship at the University of Aberdeen.

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8. OCCURRENCE OF FINN'S BAYA (*PLOCEUS MEGARHYNCHUS* HUME) IN DARRANG DISTRICT, ASSAM

(*With a photograph*)

The Finn's Baya, *Ploceus megarhynchus* Hume, has always been a subject of great interest to the ornithologists for its alleged rarity.

It was first obtained from Kaladoongi, Naini Tal District, U.P., by its describer A. O. Hume in December 1866. In 1901, Frank Finn obtained birds in breeding plumage from a Calcutta bird dealer, said to have come from Naini Tal. Later, in 1912, H. V. O'Donel found for the first time its breeding colony in Bhutan Duars (= Hasimara, Jalpaiguri District, W.B.), and obtained some birds too.

During the next four decades, though a few birds turned up from time to time in the Calcutta bird market, their exact provenance was not known. It was, therefore, supposed to be very rare and an endangered species.

In 1934, Sálim Ali undertook a special expedition to Kaladoongi but his mission failed to locate the bird or to procure any workable clue concerning its whereabouts. Again, in 1953, Sálim Ali and H. Alexander made a second fruitless quest there. But in 1959 (July-August) Sálim Ali and J. H. Crook rediscovered the species with its breeding colonies in the Rampur and Haldwani districts, U.P. (Ali & Crook 1959). Later, V. C. Ambedkar revisited the area and studied its breeding habits (Ambedkar 1968). In eastern India, after O'Donel, W. Koelz obtained specimens from Agia, Goalpara District, Assam, and they were separated into an eastern subspecies, *Ploceus megarhynchus salimalii*, by H. Abdulali (Abdulali 1960). Saha reported on its occurrence, and described its nests, eggs and chicks in a breeding colony in the Salt Lakes near Calcutta (Saha 1967), presumably formed by escapees from the Calcutta bird market.

During a recent field trip in Darrang District, Assam, a colony of the Finn's Baya was found by me near Dharamjuligarh area, some 100 km north of Rangia Railway station on 5 June 1975.

The habitat is typically duars, in the foothills region. The area is a grassland, dominated by Elephant grass, periodically burnt during the dry seasons. Much of the land has

been reclaimed for cultivation by the increasing human settlements. Traditional tea gardens, however, prevail throughout the area. Clusters of villages are dotted everywhere. The terrain is flat, but cris-crossed with numerous deep nullahs, all being the tributaries of the Suklai river. The nullahs remain dry during most of the year, except when the rain water flows after a heavy shower in the hills of Bhutan and adjacent areas. There is extensive cultivation all around the villages. Dharamjuligarh, locally called Rajagarh, is a typical village, some 2 to 3 km north of the Dharamjuli Tea Garden. Within the village, between two plots of cultivated fields stood a Silk Cotton (*Bombax ceiba*) tree, on the top of which the colony of the Finn's Baya was found. Nests in the colony numbered 24, all complete, and were placed some 9 to 11 m above the ground. The nests and the colony agreed with the descriptions of those from Kumaon, U.P. in all respects (Ali & Crook 1959).

Thirty-five birds, all adults, could be spot-

Photo. 1. Nests in colony of the Finn's Baya (*Ploceus megarhynchus* Hume) on a Silk Cotton (*Bombax ceiba*) tree.

ted in the colony. The males were in lesser number than the females (in a ratio of approximately 3 : 4), a clear indication of polygamy. The birds were very agile and noisy, and were frequently leaving the colony to bring something in. A few individuals were seen bringing inflorescence of the maize (*Zea mays*), obviously to make the inner lining of the nests.

In the adjacent areas, breeding colonies of the Common Baya (*P. philippinus*) were found in the Betel nut (*Areca catechu*) plants, while those of the Streaked Baya (*P. manyar*) were found in the Elephant grass (*Saccharum* sp.). All the three species were apparently feeding on the same ground, i.e. in the paddy fields or in the grass jungles.

Breeding colonies of the Finn's Baya have been recorded from Kumaon terai (Ali & Crook 1959; Ambedkar 1968), from Bhutan Duars (O'Donel 1916) and from lower Bengal (Saha 1967). Nests are built in tree-tops, in the grasses or in the reed-beds. Although Baker (1934) reported O'Donel's findings as nests built in the grasses, O'Donel (1916) himself and Inglis (1920), who recorded O'Donel's findings, confirmed that in the Bhutan Duars the nests were actually built in tree-tops. The present findings, thus, confirm that the breeding habit and habitats of the eastern subspecies, which was apparently known to make their nests only in the grasses and reeds, are indeed similar to that of the nominate subspecies.

So far as distribution is concerned, the eastern limit of the species was known from Agia, Goalpara District, Assam. The present finding, therefore, extends the range of the species further north-eastward to Darrang District of Assam.

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9. SIGHT RECORDS OF UNUSUAL BIRDS FROM COLABA POINT, BOMBAY, MAHARASHTRA

The southernmost tip of Bombay Island, Colaba Point, provides an excellent habitat for roosting gulls and terns. The remnant patch of mangroves, the open golf course and the surrounding vegetation also provide shelter and refuge for many migrants moving south in the autumn. The shape and position of the peninsula tends to funnel the migrants moving down the coast so that a concentration of birds is to be found at the tip, creating an area that has considerable potential as a ringing station or an observatory.

The observer spent several days in the area in late 1974 (26-28 October, 17-20 November). The following species are of interest because of their rare occurrences in the Bombay region. All are well known to me in parts of the world where they are of regular occurrence. A draft of this note was shown to Mr Humayun Abdulali and his remarks are included in parenthesis under each species.

Wilson's Storm Petrel **Oceanites oceanicus.** Two birds were sighted offshore in 17th November and were identified by their flight characteristics combined with the feet projecting beyond the end of the tail. Not previously recorded in the Bombay area.

[Sinclair (*JBNHS* 1: 167) said it was known but rare along the Konkan, but there was no further record in the neighbourhood until a specimen was collected out of a party of 8-10 birds at the entrance to Bombay Harbour on 22 October 1947, several single birds having been seen a few miles southwards on the same day (ibid. 47: 550).]

Crab Plover **Dromas ardeola.** An adult and an immature bird were seen feeding near the mangroves on 27th October. Unmistakable, large, long legged, black-and-white wader with a large heavy bill.

[This is now rare near Bombay and the only available records are of individuals shot/seen at Thal and Rewas, Kolaba district, on the mainland almost opposite Colaba in Bombay, both on 26 October 1930 and 1935.]

Kentish Plover **Charadrius alexandrinus.** Many birds seen on most days in mixed flocks with Mongolian (*C. mongolus*) and Large Sandplovers (*C. leschenaulti*).

[Horace Alexander noted them at Colaba on 25 February 1949 (*JBNHS* 49: 311) and we saw them again together in February 1951. They are presumably regular visitors though confused with the Large Sandplovers and overlooked.]

Arctic Skua **Stercorarius parasiticus.** Parasitic or Richardson's Skua Birds were sighted almost daily and may have involved five individuals. Observed chasing small gulls and terns.

[I was shown an unmistakable skua chasing a Lesser Crested Tern, *Sterna bengalensis*.]

Pomatorhine Skua **Stercorarius pomarinus.** Two adults seen pursuing an immature Herring Gull *Larus argentatus*.

[Our only records are from Ceylon.]

Slenderbilled Gull **Larus genei.** One seen on 26th October and two on 18th November. Not easily separable from the Blackheaded Gull. *L. ridibundus* but the longer decurved bill rules out confusion.

[Br A. Navarro, S.J. has seen and obtained specimens near Bombay in December/January (*JBNHS* 65: 218).]

Whitewinged Black Tern **Chlidonias leucopterus.** Four birds positively identified on 27th October; separated in the field from the Whiskered Tern *C. hybrida* by the daintier flight, paler rump and the 'saddle' appearance on the immatures seen.

[I have published a sight record supported by Horace Alexander on 31 March 1950 (*JBNHS* 49: 310) and others have been subsequently reported. The Bird Migration Camp at Point Calimere ring-

ed some 50 birds but no specimen has been obtained from Indian limits. Some of the terns including *S. hirundo*, are very confusing and it would be well to obtain specimens in support of the first few records.]

Common Tern **Sterna hirundo.** Over 400 birds in October with a few present in November. Dark wing tips, grey rump and longer tarsus separates this from the very similar Arctic Tern *S. paradisaea* in winter plumage, the latter not being present.

Short-toed Larks **Calandrella cinerea.** Flocks of 100 and over were seen feeding near the golf on most days.

[Flocks often seen on dry open land adjoining salt pans, mangrove, etc. October to February.]

Many more Palaearctic migrants were seen in the area in fluctuating numbers. The species involved were mostly wheatears, warblers, redstarts, bluethroats, bee-eaters and a continual stream of swallows.

This area would be excellent for migrational studies by local ornithologists and is only a few minutes by bus from the Society's rooms.

120, Madeline Road,
Morningside,
Durban 4001,
South Africa,
March 25, 1976.

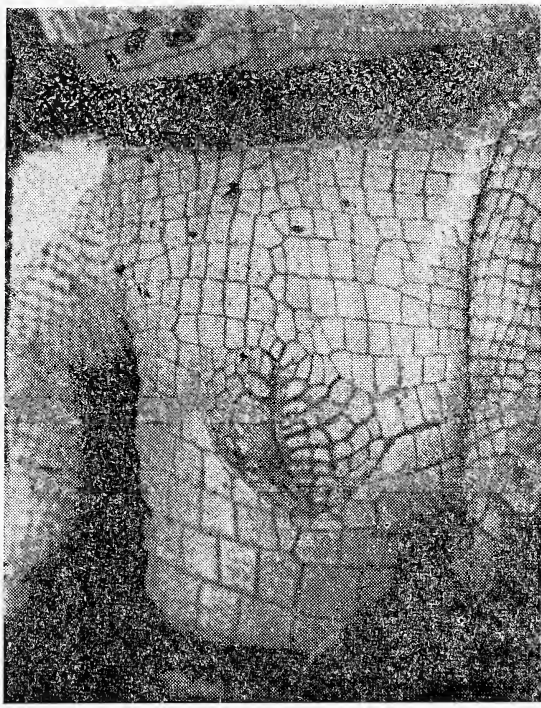
J. C. SINCLAIR

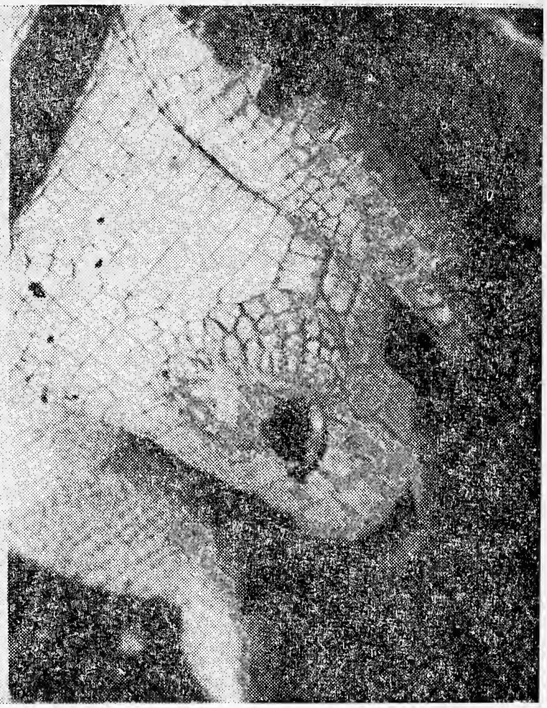
10. A NOTE ON CROCODILIAN SEX DETERMINATION
(*With two photographs*)

Rene Honegger has written in IUCN Bulletin 32 (1971) that the sex of living crocodiles of certain species can be determined by manual probing of the cloaca of specimens over 75 cm in length. Other methods include body size comparisons in large adults (the male grows larger) and scalation (the scales surrounding the cloaca are larger in the males of some species) but these are limited in scope and accuracy.

We have one *Alligator mississipiensis* 129 cm long and one 15 year old *Crocodylus palustris* 195 cm long. On transferring them recently we were able to check and determine their sex by the manual probing method. The Alligator proved to be a female with an unobstructed cloacal passage. The Marsh Crocodile is a male, the penis being a soft obstruction about 7 cm inside the cloaca. An unexpected bonus was that the crocodile extruded its penis about 12 cm while it was being checked resulting in the accompanying photograph.

Sex determination by external features is extremely difficult in many reptiles but very important when planning breeding and rearing programmes such as a crocodile farm. The success of the Samut Prakan Crocodile Farm in Thailand with its population of 11,000 crocodiles (*C. siamensis* and *C. porosus*) points to very good chances of successful crocodile farming in India. This will be a necessity to save India's three crocodilians and can be an economically profitable project as well.





1 2

Photo. 1. Slightly elevated area of a crocodile with penis withdrawn. Photo. 2. Tip of the penis of an adult male Marsh Crocodile.

MADRAS SNAKE PARK TRUST,
GUINDY DEER PARK,
MADRAS 600 022,
March 21, 1973.

R. WHITAKER

11. GROWTH STUDIES ON TWO SPECIES OF CROCODILES IN CAPTIVITY

Information on the economics of rearing crocodiles in captivity in India is almost lacking and the available literature (Daniel 1970, Misra 1970) points to the danger of Indian species facing the threat of extinction due to illegal hunting for skins. The preliminary survey of Bustard (1974) lays stress on the importance of crocodile farming in our country from the view point of both conservation and economic return.

The present study deals with the growth rates of two species of crocodiles namely *Crocodylus palustris* and *C. porosus* in captivity. These studies tend to show that they

TABLE

GROWTH RATES (LENGTH/GIRTH) OF *C. palustris* AND *C. porosus* IN CAPTIVITY (MEASUREMENTS TAKEN IN JULY EVERY YEAR IN CENTIMETRES)*

Year	1971	1972	1973	1974	1975
C. palustris	40/16	51/21	89/34	130/52	179/67
C. porosus	—	87/29	130/44	153/52	168/55

* Average of measurments of five individuals.

exhibit variation in their growth rates (see Table). The average seasonal rainfall seems to have a direct bearing on the growth and this point has also been observed by others. (U. Tai Yangprapakorn *et al.* 1971).

The juveniles of *C. palustris* were obtained from Chidambaram municipality of South Arcot District in August 1970, and were approximately 15 months old while those of *C. porosus* were obtained from Singapore in April 1972, and were approximately 2 years old. Further details regarding this study such as effect of habitat and climate on the growth rate and economics of rearing for commercial purposes will be published elsewhere.

ACKNOWLEDGEMENTS

Thanks are due to Prof. Y. Nayudamma, Director-General, CSIR, New Delhi and Prof. M. Santappa, Director, CLRI, Madras for their keen interest in this study.

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R. BHASKARAN

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February 7, 1976.

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12. COLOUR DURING LIFE OF THE SPINYCHEEKED ANEMONE FISH *PREMNAS BIACULEATUS* (BLOCH)

(*With a text-figure*)

In February 1974, Mr D. H. Mhasawade, the then Curator, Taraporevala Aquarium, Bombay, and Rodney Jonklaas of Sri Lanka, brought back alive from the Andaman Islands, together with other fishes, a pair of anemone fish.

Although these fishes normally live in symbiosis with a sea anemone, and no sea anemone was collected from the Andaman Islands or made available to them at the Taraporevala Aquarium, the anemone fishes soon made themselves at home in a 180 cm × 60 cm × 60 cm aquarium, the other occupants being a pair of the Anemone Fish *Amphiprion ephippium* (Bloch) (also collected in the Andaman Islands), several Clown Fish [*Amphiprion percula* (Lacepède)] (from Sri Lanka) and Yellow-tailed Blue Damsel Fish (*Pomacentrus melanochir*).

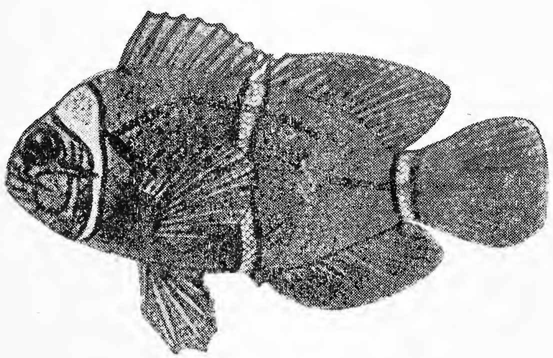

Fig. 1. Spinycheeked Anemone Fish *Premnas biaculeatus* (Bloch).

That the fishes were really anemone fish was apparent from the colour pattern—vertical stripes on a chestnut-brown body, and from the peculiar swimming pattern which has variously been described as "bobbing" or "see-sawing", comprising a rapid elevation and depression of the anterior portion of the body. However, they did not have the chalk-white bands which are present in most species of the genus *Amphiprion*. Instead, there were three sulphur-yellow bands; the first band passed behind the head in a curved "collar", similar to that found in *Amphiprion percula*. The second was straight, starting from the juncture of the spiny and soft portions of the dorsal fin and extending to the ventral part of the body. This band was quite broad dorsally but abruptly narrowed to a stripe. The third band was over the free portion of the caudal peduncle. All the three bands were edged with pale blue.

Identification of the fishes could not be carried out while they were alive, as the specific characters, such as fin-ray and scale count could not then be made. One of the fishes must have died and been eaten by the others before its body could be recovered for examination. The other one (of total length 63 mm) lived till October, 1975 and was fortunately well preserved thereafter. On examination, it turned out to be *Premnas biaculeatus* (Bloch). This is the only species belonging to the genus, which latter can be distinguished from all other genera of the family Pomacentridae by having a strong sub-orbital spine directed backwards and a smaller pre-orbital spine, about equal to the eye.

The bands on anemone fishes of the genus *Amphiprion* are chalky-white or ivory, and usually are edged with black. Woods & Schultz (1960), in their key to the fishes of the family Pomacentridae, use the term "pale bands". Day (1878) describes the bands as "white...

margins with black". De Beaufort (1940), too, mentions "three chalky white transverse bands, lined with black."

Day gives the habitat of *Premnas biaculeatus* as "Seas of India to the Malay Archipelago and beyond". This would lead one to expect that it is widespread along Indian coasts. However, this does not seem to be so. It is not recorded by Munro (1955) from Sri Lanka. If this species had occurred in South African waters, Smith (1953) would have given, besides its diagnostic features, an accurate colour description and a colour-illustration, as he based his colour plates on sketches made from freshly dead specimens, or, if this was not possible, on notes made at that time. Unfortunately, however, the species does not appear to extend to those seas, since he has recorded only two species of anemone fishes, namely *Amphiprion polymnus* (Linnaeus) and *A. bicinctus* Ruppell.

It is interesting to note that, on preservation in formalin, the colours of the specimen soon changed. Within a month and a half, the vivid yellow of the bands had faded to white, while the pale blue edging darkened to black. The brown coloration of the body, however, remained unchanged. It may, therefore, be remarked that the previous descriptions of coloration in *Premnas biaculeatus* have been based on preserved specimens.

ACKNOWLEDGEMENTS

I am grateful to Mr A. V. Sheode, Curator, Taraporevala Aquarium, Bombay, for making available the specimen for examination.

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E-31, CUSROW BAUG,
COLABA CAUSEWAY,
BOMBAY 400 039,
December 31, 1977.

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13. ON THE SPECIFIC VALIDITY AND DISTRIBUTION OF THE LOACH, *LEPIDOCEPHALUS ANNANDALEI* (CHAUDHURI) (CYPRINIFORMES: COBITIDAE)

(*With a text-figure*)

Chaudhuri (1912) originally described *Lepidocephalus annandalei* based on the specimens collected from River Mahananda at Siliguri and River Tista near Jalpaiguri, West Bengal (India). Subsequently, Shaw & Shebbeare (1937) reported this species from River

Panchenai near Matighara (West Bengal). Thus *L. annandalei* is so far known only from northern Bengal.

A perusal of literature on the Indian Cobitidae reveals that there exists some confusion regarding specific validity of *L. annandalei*. figure of *L. annandalei*, except in the disposition of barbels. The rostral pair is minute and narrow, the two maxillary pairs are distinct and close-together (inner pair is longer) and the mandibular pair is broad and well developed.

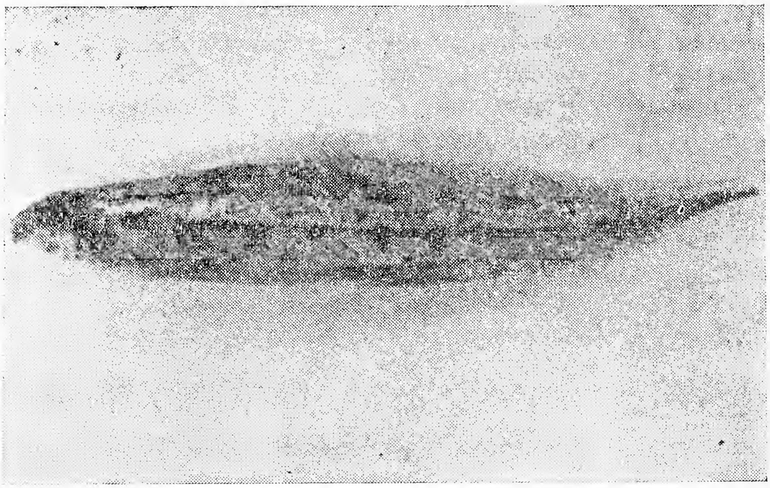

Fig. 1. *Lepidocephalus annandalei* (Chaudhuri).

Menon (1963), in his distributional list of fishes of the Himalayas, regarded *L. annandalei* as a valid species but later in his checklist (1974) of fishes of the Himalayan and Indo-gangetic plains, he considered this species as a synonym of *L. guntea* (Ham.). Similarly, Banarescu & Nalbant (1966), in their account of Cobitidae collected by the German-India Expedition, pointed out that *L. annandalei* may be a synonym of *L. thermalis* (Val.).

Recently, three specimens (29.0 to 40.0 mm in total length) of *L. annandalei* were found in the fish collection of Kaziranga Wild Life Sanctuary, Assam (India) which were received for identification from our Eastern Regional Station, Shillong, Meghalaya. These specimens agree well with the original description and

L. annandalei can be easily distinguished from its close allies, *L. guntea* and *L. thermalis*, by the characteristic body profile with an abrupt compression at caudal base and large eyes, the diameter of which is greater than inter-orbital distance and more than half the snout length.

The present record of *L. annandalei* from Kaziranga Sanctuary, which is situated on the southern bank of River Brahmaputra in Sibsagar District of Assam, extends the distributional range of this species considerably eastwards.

ACKNOWLEDGEMENTS

I am grateful to Dr B. K. Tikader, Deputy Director, for kindly providing necessary facilities.

ZOOLOGICAL SURVEY OF INDIA,
WESTERN REGIONAL STATION,
POONA 5,
March 24, 1976.

G. M. YAZDANI

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14. OCCURRENCE OF THE ANCHOVY *COILIA KORUA* ON THE WEST COAST OF INDIA

The Rat-tailed Anchovy *Coilia korua* Dutt & Seshagiri Rao 1972 has been originally described from Gollapalem, Andhra Coast. The species can be identified on the following characters. Br. St. 10-11, D I 12, P xii-xiii (free filaments) + 5-7, V i 5-6, A 101-106, g.r. 23-26 + 30-33, scutes 7-9 + 9-11 (total, 17-19) and with maxilla not reaching the gill opening. *C. korua* occurs in Hoogly estuary (Whitehead 1972), at Kakinada (Rao 1975) and Gollapalem on the Andhra Coast. The species is now being recorded for the first time from Bombay based on 5 specimens 93-106 mm S.L. collected on 14-i-1975 along with *C. dussumieri* and *C. ramacarati.* The following counts were made. D I 13-15, P xii (free filaments) + 7, V 7, A 104-110, g.r. 24-25 + 32-33, scutes 8-9 + 9-12 (total, 17-20). *C. korua* is likely to occur on the Southwest Coast of India also.

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ANDHRA PRADESH,
July 6, 1976.

B. V. SESHAGIRI RAO

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15. AN INSTANCE OF UNUSUAL FEEDING BEHAVIOUR OF THE INDIAN MACKEREL, *RASTRELLIGER KANAGURTA* (CUVIER) OFF MANGALORE

Information on the food of the Indian mackerel, *Rastrelliger kanagurta* (Cuvier) from the seas around India was summarised by Venkatraman (1970). Though data on this subject are quite extensive, it is significant that specific references to *Acetes* as an item of food of this fish are few (Kuthalingam 1956; Kutty 1965; Jones & Rosa 1965 and Luther 1973). In this context, the present report of intensive feeding of adult mackerel almost exclusively on species of *Acetes* is noteworthy. This is the first report of the kind from the seas around India.

Fifty two specimens, ranging in size from 218 to 250 mm in total length and weighing 100 to 170 gm and in stage II of maturity (both males and females, former predominating, ova ranging in size from 0.14 to 0.84 mm, majority 0.44 to 0.56 mm) obtained from drift net catches off Mangalore in the month of May 1975, had gorged stomachs. The contents, which varied from 2 to 5.5 ml were composed almost exclusively of two species of *Acetes,* namely *A. cochinensis* Rao and *A. japonicus* Kishinouye, ranging in size from 10 to 21 mm in total length and numbering 36 to 206 individuals per stomach. Besides *Acetes,* only traces of semi-digested parts of copepods were found in the stomach contents.

Most workers agree that the mackerel is primarily a plankton feeder (Venkataraman, op. cit.). However, at times, it resorts to bottom feeding (Bhimachar & George 1952; Kutty 1965). Differences in the food of young and adult stages (Chidambaram 1944; Devanesan & Chidambaran 1948; Kuthalingam op. cit. and Rao & Rao 1957) as well as instances of heavy feeding on *Stolephorus* (Tham Ah Kow 1950) and clupeids (Venkataraman & Mukundan 1970) are on record. The present report of intensive feeding on *Acetes* indicates that it is one of the important substitute items of food of adults, supporting the view that the mackerel is a facultative type of feeder, capable of modifying its diet depending on the availability of different organisms in the environment (Rao 1965).

Swarms of *Acetes* are known to occur in the inshore waters and ascend up the estuaries in this region during this time of the year. The senior author found *Acetes* to be an important item of food of other fishes also like *Lactarius lactarius* and *Trichiurus lepturus* at the same time in this area. Occurrence of immature individuals of *L. lactarius* (35 to 112 mm total length) in large numbers in the inshore waters off Mangalore during this period has been correlated with occurrence of swarms of *Acetes* in the area (James *et al.* 1974).

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March 16, 1976.

P. S. B. R. JAMES
P. SANTHA JOSEPH

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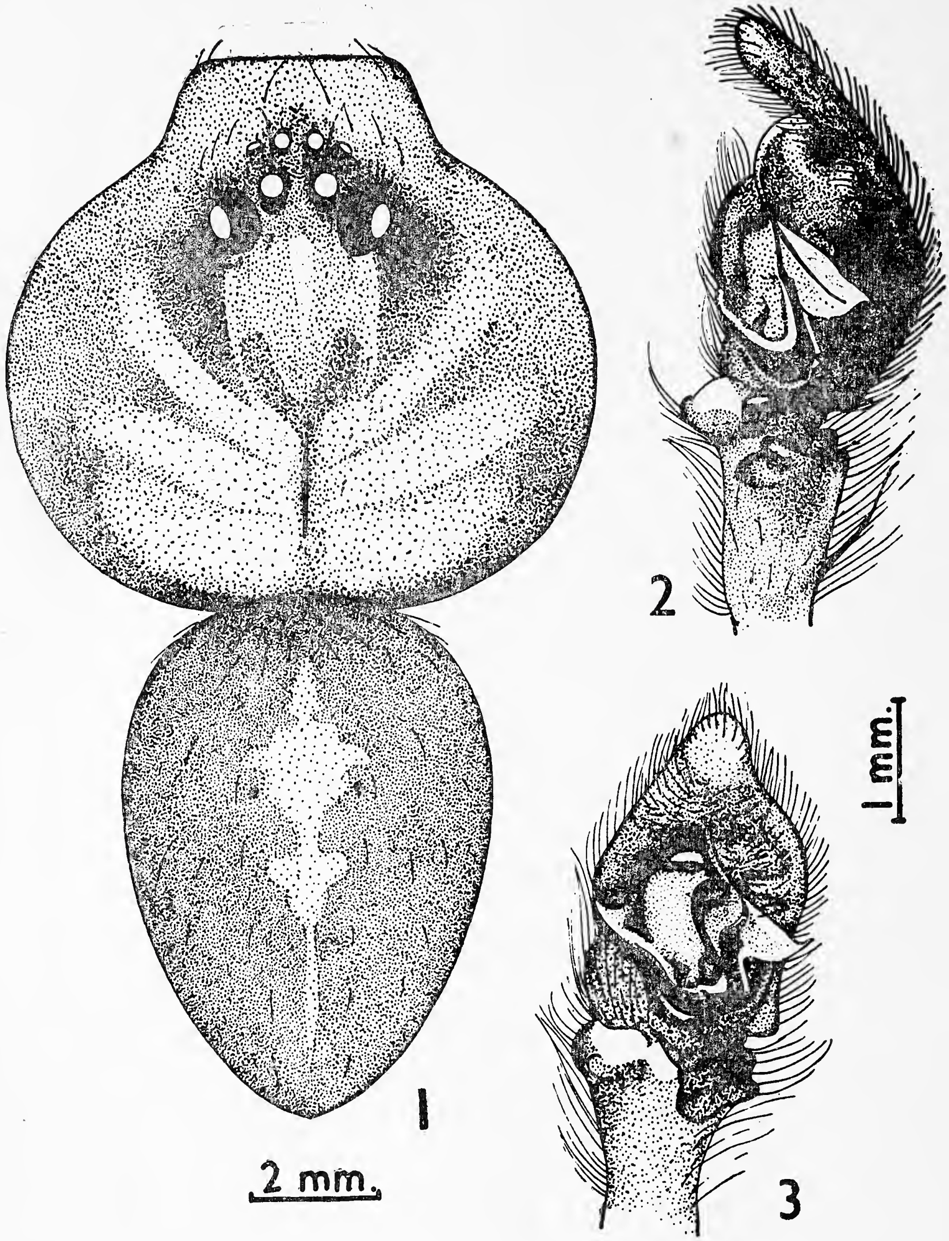
16. REDESCRIPTION OF TYPE SPECIMENS OF THE SPECIES *EUCAMPTOPUS CORONATUS* POCOCK AND *EUPROSTHENOPS ELLIOTI* (CAMBRIDGE) (FAM. PISAURIDAE) WITH CRITICAL NOTES

(*With seven text-figures*)

Introduction

During the course of revisionary studies of the family Lycosidae from India, we got an opportunity to examine the type specimens of Indian lycosids deposited in the British Museum (Natural History), London and Oxford University Museum, Oxford, which were originally described by the Pocock and Cambridge. While examining these type-specimens, we found that two species, namely *Eucamptopus coronatus* Pocock 1900 and *Euprosthenops ellioti* (Camb.) 1877, were wrongly placed in the family Lycosidae. Pocock had erected two new genera in the family Lycosidae, namely *Eucamptopus* Pocock 1900 and *Euprosthenops* Pocock 1897, which actually should be placed in the family Pisauridae. The purpose of the present paper is to clear the position of these genera and species in the family Lycosidae. The original descriptions of the two species are inadequate and without proper illustrations. Hence we are redescribing and illustrating the two species in detail.



Figs. 1-3. *Eucamptopus coronatus* Pocock
(1) Dorsal view of male, legs omitted. (2) Lateral view of male palp. (3) Ventral view of male palp.

1. **Eucamptopus coronatus** Pocock

Eucamptopus coronatus Pocock, 1900, *Faun. Brit. Ind. Arachnida.,* London, p. 245.

General. Carapace and legs chocolate-brown and abdomen brown. Total length 17.00 mm. Carapace 9.00 mm long, 9.00 mm wide; abdomen 8.20 mm long, 6.00 mm wide.

Cephalothorax. Nearly as long as wide, round, except the anterior narrowing portion, high in the middle, convex with a prominent fovea at the highest portion of cephalothorax. The sub-marginal areas of thoracic region dirty brown and base of carapace and ocular area deep brown in colour. Clypeus slanting. Eyes in two rows, both rows recurved but posterior row strongly recurved. Eyes of the anterior row smaller than posterior row and medians slightly larger than the laterals; posterior row nearly equal in size, bases of posterior row of eyes provided with deep brown patches as in figure 1. Ocular quad slightly longer than wide and narrowing in front. Sternum heart shaped, pointed behind, clothed with erect spine-like hairs, sternum depressed than the base of coxae. Labium longer than wide with a notch at the proximal end. Maxillae wider at the distal end and provided with conspicuous scopulae. Chelicerae slender and outer side with conspicuous scopulae and hairs, inner margin with four strong pointed teeth and outer margin with two teeth. Legs very long, strong and slender, clothed with spines and hairs, tibiae I and II with four pairs of ventral spines, tibiae III and IV with one dorsal spine. Apophysis of male palp very prominent, as in figures 2 & 3.

Abdomen. Slightly longer than wide, clothed with pubescence and spine-like hairs. Mid-dorsally provided with a pale longitudinal patch as in figure 1. Ventral side pale, clothed with pubescence. Posterior spinnerets longer than the anterior spinnerets, apical piece of anterior spinnerets short and round with cap-like appearance.

Type-specimen. One male deposited in B.M. (N.H.), London. Reg. No. 99.924.7. *Type-locality.* Tinnevelly, South India. *Distribution.* India.

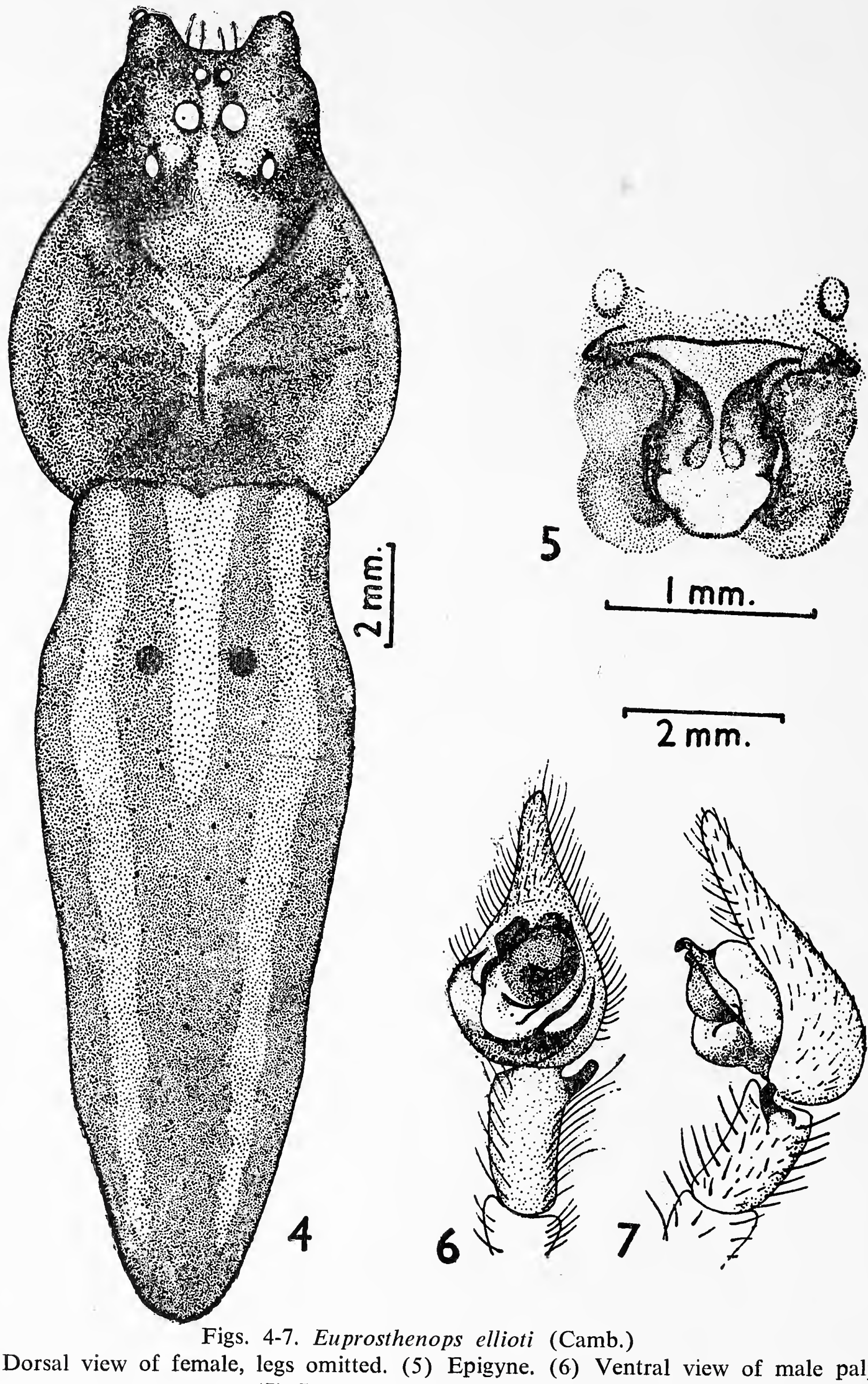
2. **Euprosthenops ellioti** (Camb.)

Podophthalma ellioti Cambridge, 1877, *Proc. Zool. Soc.,* p. 567.

Euprosthenops ellioti Pocock, 1900, *Faun. Brit. India Arachnida,* London, p. 249.

General. Carapace and legs brown, abdomen pale brown. Total length 24.50 mm. Carapace 9.50 mm long, 7.00 mm wide; abdomen 15.50 mm long, 6.00 mm wide.

Cephalothorax. Longer than wide, narrowing anteriorly, flat and clothed with pubescence. Thoracic region provided with a distinct depressed fovea. Anterior row of eyes strongly procurved and posterior row strongly recurved so as to form four rows of two eyes each. Anterior medians smaller than others, anterior lateral eyes situated much forward on the prominence projected anteriorly. Posterior medians slightly larger than the posterior laterals. Pósterior lateral eyes provided with tubercles. Ocular quad longer than wide and narrowing in front as in figure 4. Sternum heart shaped, pointed behind, clothed with pubescence and spine-like hairs. Labium longer than wide with a notch at the base. Maxillae slightly wider at the distal end and provided with conspicuous scopulae. Chelicerae strong, outer side provided with spine-like hairs; inner and outer margin each with three teeth. Legs very long and slender, clothed with hairs and spines, provided with transverse brown bands dorsally; tarsi and metatarsi of I and II provided with five pairs and three pairs of ventral robust spines respect-



Figs. 4-7. *Euprosthenops ellioti* (Camb.)
(4) Dorsal view of female, legs omitted. (5) Epigyne. (6) Ventral view of male palp. (7) Lateral view of male palp.

ively. Tibial apophysis of male palp prominent, as in figures 6, 7.

Abdomen. Narrow and very long, tapering behind, clothed with pubescence, antero-mid-dorsally with two conspicuous brown spots and dorsal middle with longitudinal pale lens-shaped marking. Mid-dorsally with a light brown longitudinal band. Ventral side pale. Epigyne as in figure 5. Male slightly smaller and darker than female.

Type-specimens. One mature female, one mature male and one subadult female deposited in University Museum, Oxford. Regd. No. 1513. *Type-locality.* Eastern Central India. *Distribution.* India.

Remarks. There are some characters which are common both to Lycosidae as well as to Pisauridae. For example the posterior row of eyes is strongly recurved in the family Lycosidae as well as in some genera of the family Pisauridae. The trochanters are also notched in both the families and tarsi bears three claws in both the families. It appears that both Pocock and Cambridge may have been mislead by the characters in placing these species in the family Lycosidae instead of Pisauridae.

The members of the family Pisauridae differ from those of Lycosidae in that the tibia of the pedipalp of male pisaurids are provided with an external apophysis which is lacking in the lycosids. The other striking difference is the length of legs and position of legs at the resting position. Pisaurids have long and slender legs as compared to the lycosids. The structure of the pedicel is that in Pisauridae the parts or the lorum of the pedicel are either united by a transverse suture or the anterior piece is furnished with a notch behind into which a projection of the posterior piece fits; while in the Lycosidae the lorum of the pedicel is composed of two pieces of which posterior one is notched to receive the anterior one. The type specimens of *Eucamptopus coronatus* Pocock and *Euprosthenops ellioti* (Camb.) agree in the above characters with Pisauridae and therefore the two species have been removed from the family Lycosidae and placed under the family Pisauridae.

ACKNOWLEDGEMENTS

Our thanks are due to Mr F. R. Wanless, in charge of the Arachnida Division, British Museum (Natural History), London and Mr E. Taylor, Hope Department of Entomology, University Museum, Oxford, who were kind enough to send the type-specimens for our studies.

ZOOLOGICAL SURVEY OF INDIA,
WESTERN REGIONAL STATION,
POONA 5,
January 22, 1976,

B. K. TIKADER
M. S. MALHOTRA

17. *DELIAS EUCHARIS* LINN. (LEPIDOPTERA, PIERIDAE) AS A CONTROL OF THE PLANT PARASITE *DENDROPHTHOE FALCATA* (LINN.) (= *LORANTHUS LONGIFLORUS* DESR.) IN HYDERABAD, ANDHRA PRADESH

(*With a photograph*)

Loranthus is a partial perennial parasite of economic plants such as mango, guava, pomegranate, banyan, etc. much to the detriment of the host plant. In Hyderabad it is also observed to grow on cotton plants and those supporting Loranthus produce lesser number of bolls than the plants free from it.

Of the many species of Loranthus, *Dendrophthoe falcata* is a common one and while surveying for natural enemies of insect pests of crops in Hyderabad, the plant parasite was seen to be attacked by caterpillars of *Delias eucharis* in large numbers. The caterpillars feed voraciously on Loranthus leaves and were able to keep the cotton plant free from it within a few days. Looking to the destructive potential of the butterfly the nature of damage, life-history, feeding capacity, etc. were studied in the laboratory.

Nature of damage. The caterpillars, a few hours after hatching start scraping the leaves of the parasite, and in the second instar they are capable of cutting the leaves along the margin. Caterpillars up to six in number were found on a leaf. In the 3rd, 4th and 5th instars they feed gregariously on leaves eating away even the midribs and tender branches of the host. Thus the entire parasite is defoliated within a few days of attack, seriously jeopardising its survival. The twigs without the leaves gradually dry out if fresh leaves do not appear.

So far the caterpillars have not been seen to attack any other plant except Loranthus. They, however, do not survive without the specific host for more than seven days.

An interesting habit of the caterpillars is that, they start and stop feeding simultaneously. It appears that their activity is guided by mutual stimulation.

Life-History

The female butterfly lays eggs in batches of 20 to 60. Up to 100 eggs may be laid by a single butterfly. The eggs are laid either on the dorsal or ventral side of the leaves and firmly glued to the surface.

Eggs are creamy white in colour becoming yellow at the time of hatching, dome shaped and measure 800 μ in length and 400 μ in width. Under the microscope, the eggs show a white ring on the top and from this ring longitudinal lines radiate upto 2/3 part of its length.

Freshly hatched caterpillars are very minute, about 1 mm in size, brownish yellow in colour with black head and abdomen covered with white hairs. In size, the full grown caterpillar is 40 to 45 mm in length and 5 to 6 mm in width. The body of the mature caterpillar is slightly yellowish in colour, interspersed with white spots giving rise to white setae. On the dorsal surface of each segment, 2 large white spots in the front bearing long setae and 10 small spots in the back bearing short setae are present.

Prepupal period. Prepupal period is 1 to 2 days during which caterpillar stops feeding and becomes pale yellow in colour and 30 to 35 mm in length. When they get a suitable place, generally the leaves or twig of Loranthus, they adhere firmly to pupate.

TABLE 1

INCUBATION PERIOD AND DURATION OF DIFFERENT LARVAL INSTARS AND PUPAL PERIOD OF *Delias eucharis* (IN DAYS)

Month	Incubation period	Larval period I Instar	II Instar	III Instar	IV Instar	V Instar	Total larval period	Pupal period	Total life Cycle
January and February	6 to 8	4	4	4	6	4	22	14-16	42-46
August and September	5 to 6	3	3	4	5	3	18	10-12	33-36

TABLE 2

FEEDING RATE (AVERAGE) OF ONE CATERPILLAR IN 24 HOURS

Size of caterpillar	Instar	Wt. of one caterpillar	Wt. of the leaf consumed in 24 hrs. by one caterpillar	Wt. of fecal matter collected in 24 hrs. from one caterpillar
5 mm	First	0.0041 gm.	0.0029 gm.	0.0004 gm.
15 mm	2nd	0.1055 gm.	0.1360 gm.	0.0190 gm.
25 mm	3rd	0.1310 gm.	0.2071 gm.	0.1787 gm.
35 mm	4th	0.5396 gm	0.8871 gm.	0.5112 gm.
45 mm	5th	0.6696 gm.	1.4820 gm.	1.0032 gm

8

The pupae are yellow in colour and ornamented with large black and minute yellow warts on the dorsal surface of abdomen. The size of the pupa varies from 20 to 24 mm in length and 6 to 7 mm in width. There is a black knob on the head.

The size of butterfly with wings expanded varies from 65-70 mm. Dorsal surface of the wings white with prominent black wing venations, while ventral surface of the forewing is yellow at the tip and the hindwings are completely yellow with orange-red coloured border. There are 7 orange spots near the outer margin skirted with black wing venation. The male butterfly exhibits darker wing venation than the female. The longevity of the butterfly is 6-7 days.

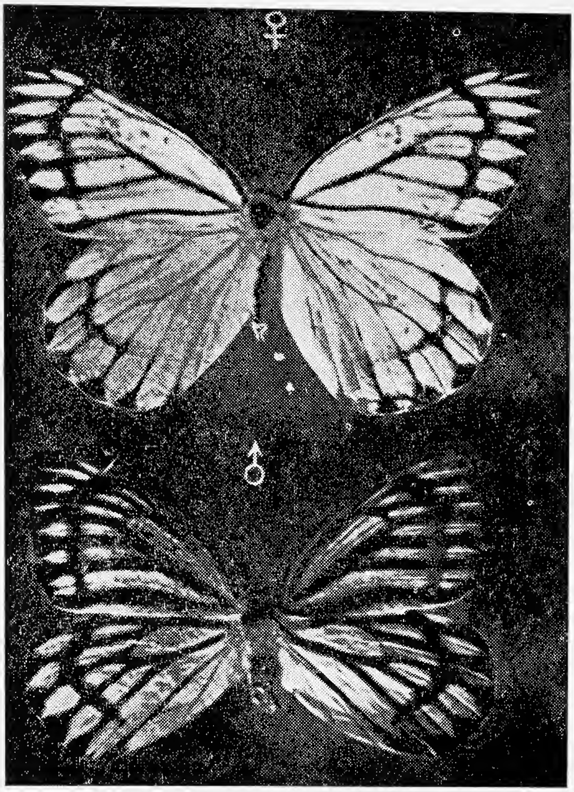


Photo. 1. Female and male butterfly.

The total life cycle is completed in 33-46 days (Table 1).

Economic importance. Loranthus is being currently eradicated by cutting or spraying copper sulphate, 2, 4-D or 2, 4, 5-T or diesel oil emulsion. The advantage of *Delia*s sp. for controlling the plant parasite can be considered in localities where it is found on cotton as this plant is extremely sensitive to hormone type of herbicides and oils. At places where caterpillars of *Delias* sp. are operating care should be taken not to spray Loranthus with any of the above chemicals which would kill the caterpillars. A dozen caterpillars of 35 mm in size can completely eat away 15 leaves from a twig in 24 hours. The feeding rate of one caterpillar according to their body weight and size is given in Table 2.

ACKNOWLEDGEMENTS

We are thankful to Dr S. N. Banerjee, Plant Protection Adviser to the Government of India, Directorate of Plant Protection, Quarantine and Storage, N.H. IV, Faridabad, Haryana and to Dr N. C. Joshi, Project Director, Central Plant Protection Training Institute, Rajendranagar, Hyderabad, for providing necessary facilities and help. Thanks are also due to the Director, British Museum, London for kindly identifying the insect.

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March 10, 1976.

18. EFFECT OF HOSTS ON THE PARASITE *BRACHYMERIA LASUS* (WALKER)

Brachymeria lasus (Hymenoptera: Chalcididae) is an insect parasite of the pupal stage of many butterflies and moths. During the course of our studies on the host-parasite relationships of this parasite we noted that the parasitised host is capable of exerting an influence on the morphology, physiology and behaviour of the adult *B. lasus* emerging from it.

The effect of hosts on the size of the parasite was found to be the most obvious influence. When the amount of food provided by the host is not adequate but just sufficient to enable the parasite to complete its development, the parasite emerges as a dwarf but normal individual. Comparatively small *Nephantis serinopa* pupae (measuring 9-12 mm in length) when parasitised by *B. lasus* gave rise to relatively smaller individuals of *B. lasus* (measuring less than 3.5-4 mm in length) whereas comparatively larger *Plusia peponis* pupae (measuring 20-25 mm in length) gave rise to relatively larger individuals (measuring more than 4-4.5 mm). The quantity of nourishment provided by *Plusia peponis* pupae is more than the quantity required for the development of the parasite *B. lasus* and some excess tissue is left over at the posterior end of the host pupa after emergence of the adult parasite. An unduly high proportion of male *B. lasus* has been observed among the dwarf individuals produced by smaller sized host pupae (such as smaller *N. serinopa* pupae).

The probable reason for the production of high proportion of males and dwarfism among the individuals that emerged from relatively smaller hosts, may be the same as pointed out by Joseph (1958) in the case of the Fig-wasp parasite (Torymidae). According to him the production of high proportion of males and the dwarfism in males of *Philotrypesis* is due to the partial starvation of the parasite larvae during development as a result of non-availability of adequate quantity of food. The same author referred to the observation of Grosch (1948) indicating that haploidy is the factor which permits the larval forms to survive better in partial starved condition. Consequently more of the males survived than the females (differential mortality of the sexes) and this resulted in a sex-ratio with higher proportions of males.

Certain physiological characteristics such as fecundity, longevity and vigour of *B. lasus* are influenced by its hosts through their effect on size. Smaller females of *B. lasus* emerging from small-sized hosts were found to be less active and less agile compared to the relatively large-sized individuals emerging from larger host pupae. Also these small-sized females laid comparatively fewer eggs than the large-sized individuals and in the smaller individuals mating was found delayed compared to large-sized individuals. The large-sized individuals were found to pierce the outer pupal cuticle of the host more easily with its ovipositor than the small-sized females. In the case of the Indian strain of *B. lasus,* the female could not succeed in thrusting its ovipositor through the hard cuticle of the pupa of *Papilio demoleus* in spite of repeated trials lasting over two minutes. However, there are instances of New Guinea specimens of *B. lasus* recorded as emerged from *Papilio aegaeus* indicating that the successful parasitization of its host by this strain of *B. lasus* may be due to its relatively larger size and probably stronger build than the Indian strain.

In view of these findings it would appear that if larger hosts are utilized for the breeding of *Brachymeria* parasites and for that matter for any mass breeding for biological control programmes, the larger sized individuals produced would certainly have advantageous characters—morphological, physiological, as well as behavioural—enabling them more readily to parasitise their hosts.

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19. A NOTE ON SEASONAL FLUCTUATION OF MIDGE POPULATION ON HYBRID SORGHUM CSH - 1

(*With a text-figure*)

Among the several insect-pests recorded infesting earheads of sorghum, the sorghum midge (*Contarinia sorghicola* Coquillet) is considered to be important. Karve (1967) observed heavy damage due to severe attack of the pest on CSH-1 and CSH-2 varieties in *Rabi* season. Dhumal (1967) reported heavy infestation in the same season. For an understanding of the incidence of the pest in three different seasons of the year, studies on the fluctuation of midge populations infesting hybrid sorghum CSH-1 were undertaken.

One hundred and fifty jowar earheads of variety CSH-1 were bagged with loose muslin cloth bags (33 cm × 16 cm, one side opened) just prior to emergence from boot. The technique used by Doering & Randolph (1963) was employed with little modification in the present experiment. Daily 10 earheads were exposed for 24 hours and kept rebagged. Such fresh exposures were continued for 15 consecutive days so that the earheads up to milk stage were exposed for egg laying. The rebagged earheads were observed daily to note the number of adults flies that emerged. Similar experiments were conducted in *Kharif*, *Rabi* and summer seasons separately. The data on the total number of adults that emerged daily following earhead emergence in different seasons are presented in the figure.

RESULTS

It is evident from the graph that midges remained active in all three seasons of the year with varying intensity of infestation. The comparative activity of the pest was judged on the basis of adult emergence from exposed earheads. The intensity of the pest on the

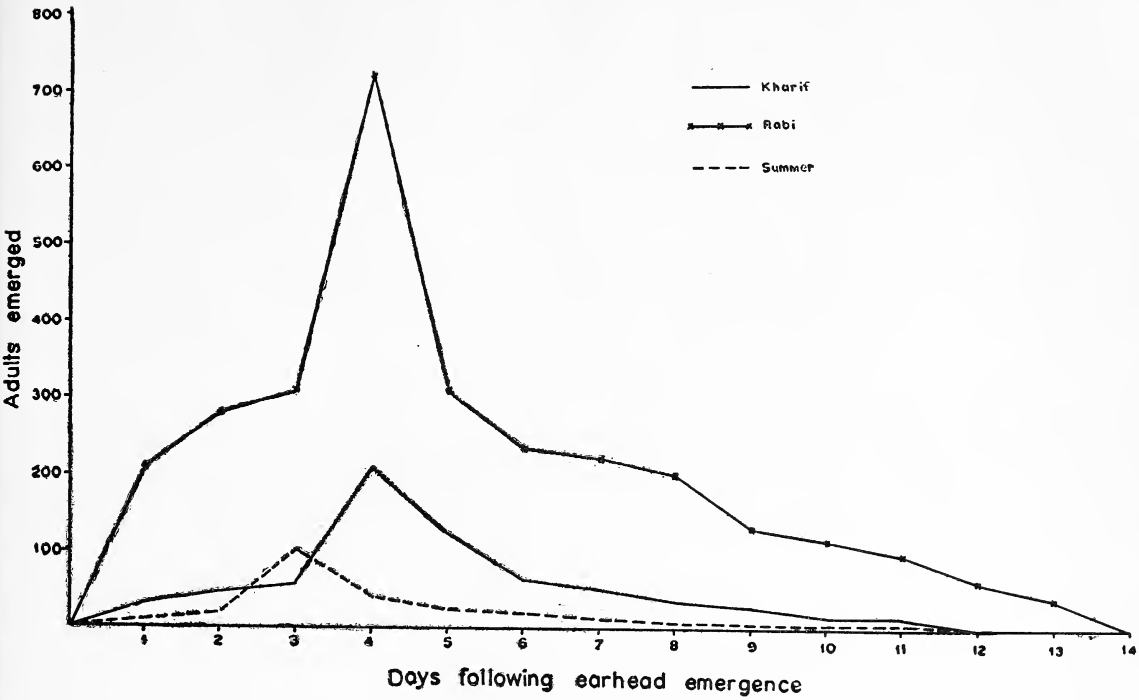

Fig. Seasonal fluctuation of midge on CSH - 1

crops was in order of (723), (206) and (99) emerged adults in *Rabi, Kharif* and summer season. In all the seasons except summer the highest population was on the 4th day from earhead emergence. In summer it was on the 3rd day. In both cases, the probable reason for highest population on 3rd day in summer and 4th day in Kharif and Rabi may be due to flowering stage of earheads which is suitable for midge attack. The average minimum and maximum temperatures were 23.30°C and 29.0°C and 11.0° and 30.6°C, 15.6°C and 34.0°C in *Kharif, Rabi* and summer seasons respectively, while relative humidity was 78.5%, 57.3% and 47% for those seasons. No co-relation was found between temperature, humidity and incidence of pest. Further, information is necessary on the ecological aspects to determine the protection measures necessary against the pest in a particular season.

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20. A NOTE ON THE SETTLEMENT OF FOULING ORGANISMS ON COPPER PLATES

(*With two text-figures*)

Observations on the settlement of fouling organisms on the copper-sheathed bottom of M.F.V. 'Harpodon' are presented with suitable illustrations. Bryozoans, serpulids and barnacles were found to be the major foulers which were capable of settling on metallic copper. The present observations on the immunity acquired by these organisms are not only of biological interest, but also of great practical value in investigations on the prevention of marine fouling.

With the introduction of various antifouling paints, the use of copper sheathing for protecting the hulls of ships and boats from the settlement of marine fouling and wood-boring organisms has diminished considerably. Further, the prohibitive cost of copper has also come in the way of its extensive use. Nevertheless, it is still considered the most effective method for preventing marine fouling and wood-borer attack (Laidlaw 1952, Redfield 1952) and is employed even now.

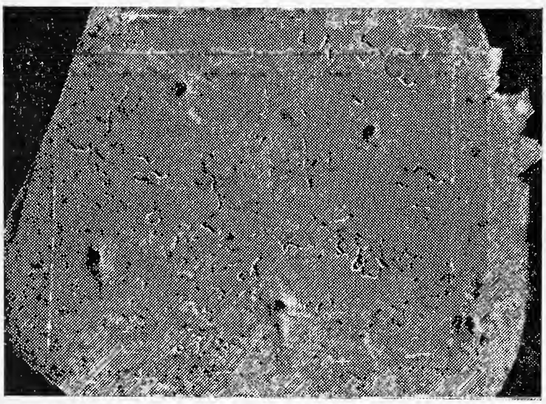

Fig. 1. A portion of Copper plate (15 × 13 cm), removed from the bottom of 'M.F.V. Harpodon', fouled by serpulids.

Gopalakrishnan and Kelkar (1958) have reported heavy fouling by bryozoans and moderate fouling by serpulids and barnacles on the copper sheathed bottom of Indian Naval crafts with wooden hulls. During the recent dry-docking of M.F.V. *Harpodon*, belonging to Central Institute of Fisheries Education, Bombay, after 14 months of operation, settlement of fouling organisms in large numbers was noticed on the copper sheet (fig. 1). An account of this unusual observation is presented in this note.

Fouling organisms collected from the copper sheathings were in the order of decreasing intensity, serpulids (*Hydroides* sp.), bryozoans (*Membranipora savarti, Electra bengalensis* and *Hippoporina* sp.) and bivalves (*Modiolus* sp.). Several specimens of *Ostrea* sp. were found growing on propeller blades. The intensity of fouling organisms counted at

six different areas is given in the Table.

It was noticed that the settlement was in patches and was not uniform throughout the bottom area. Keel proper was absolutely free from any fouling. It can be seen from the table that on the bottom of the vessel on either side of the keel up to the bilge, the settlement of serpulids and bryozoans is almost equal in number, whereas on the sides of the vessel serpulids settled in higher intensity. In general, the sides showed more settlement than the bottom. Another interesting observation is that on the edges of the plates, where copper nails have been fixed in a line, no settlement of foulers was noticed to a distance of about 2 cm.

The presence of *Ostrea* only on propeller indicates that copper may be highly poisonous to this bivalve. However, further work is necessary to obtain direct evidence on this aspect. Length of *Ostrea* ranged from 2.9 cm to 5.3 cm. The number of foulers found on the propeller blades is as follows:

Blade		Serpulids	Bryozoans	*Ostrea*
I	Inner surface (back)	8	Nil	26
	Outer surface (face)	3	—	17
II	Inner surface (back)	7	2	14
	Outer surface (face)	Nil	5	7
III	Inner surface (back)	—	30	12
	Outer surface (face)	—	11	3

TABLE

NUMBER OF FOULING ORGANISMS SETTLED ON THE COPPER SHEATHED BOTTOM OF M.F.V. *Harpodon*

Area (sq. in.)	Number of serpulids	Number of bryozoans	Mean number per sq. in. serpulids	bryozoans	Remarks
55	1750	470	32.0	8.5	Side of the vessel
15	400	160	26.7	10.7	„
4	180	21	45.0	5.2	„
6	192	5	32.0	1.0	„
6	86	94	14.3	15.7	Bottom of the vessel
9	123	112	13.7	12.4	„

The longest serpulid measured 4.2 cm, and the diameter of the largest bryozoan colony was 5.0 cm. Settlement of these two groups were also noticed on the tar sheets below, which are exposed due to damage to copper sheathing. Settlement of bryozoans on serpulids and vice versa was also observed. *Modiolus* sp. was found as stray specimens on the sides.

Settlement of foulers on the propeller baldes also was noticed. Here in addition to serpulids and bryozoans, *Ostrea* sp. was also seen. The back of blades harboured a larger number of foulers than the face.

The complete absence of barnacles, which are comparatively resistant to toxic surfaces, on the copper sheathing was rather surprising. However, during the next dry-docking of this vessel, *Balanus amphitrite* was observed in large numbers on the copper sheets. Further, copper plates immersed at Trombay, where settlement of barnacles is quite severe, indicated heavy incidence of *B. amphitrite* (fig. 2).

Fig. 2. A Copper sheet (20 × 20 cm) immersed at Trombay showing heavy settlement of small barnacles (4 per sq. cm) in two months.

Heavier fouling accumulation on the bottom of ships between the bilges than on the sides has been reported earlier, perhaps because of a geotropic response of the larvae combined with their negative phototropism (Ketchum 1952). However, in the case of *Harpodon* with a draft of 6 feet only, the difference in the intensity of settlement on the sides and the bottom observed here may be due to the fact that during low tide the vessel used to actually rest on the mud getting buried up to the bilge and therefore many specimens, settled in these areas, might have been dislocated on account of friction.

It has been reported (Edmondson 1944; Ketchum 1952a; Ryland 1965) that, among the various fouling organisms, bryozoans, barnacles and hydroids are extremely resistant to antifouling paints containing different toxic ingredients including copper, and it takes more than 12 months to foul 25% of the surface of a copper plate. In contrast to this, during the present investigation, the panel immersed at Trombay was completely fouled by barnacles within a short period of two months. The settlement of serpulids in large numbers seems to indicate a gradual process of acquiring immunity to copper by this group also. It may also be mentioned in this connection that serpulids were responsible for only 10% of the fouling on copper reported earlier by Gopalakrishnan and Kelkar (1958), 90% being constituted by the bryozoans.

It is well known that copper sheets, when in contact with other metals like iron or zinc, are prone to be fouled (Redfield 1952). In the case of copper, a dissolution rate of 10 μg Cu/cm^2/day is necessary to give it the antifouling properties. When cathodic protection is provided, using sacrificial zinc anodes, to prevent corrosion, sometimes overprotection will lead to a slower dissolution of copper below the optimum rate resulting in the fouling of the copper sheets (Ravindran & Balasubramanyan, 1974). Although cathodic protection is also given by fixing small zinc blocks at the stem and stern portions of the hull of *Harpodon*, the copper sheets are not at all overprotected so as to reduce it to a nontoxic surface. Further, as mentioned earlier, the sheets have been fixed using copper nails thereby avoiding contact with other metals. Hence the fouling of copper observed in the present case can be due to the immunity to copper developed by these organisms. This is further substantiated by the intense settlement of barnacles on copper sheets immersed at Trombay. Thus, this phenomenon is not only of biological importance but also of great practical value in investigations on the prevention of fouling with protective devices.

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21. ADDITIONS TO THE FLORA OF BIHAR AND ORISSA

In the course of my studies for three and a half years on the flora of Orissa, a number of interesting plants were collected from Ganjam, Simlipal reserve forest in Mayurbhanj district and tidal forests of Mahanadi delta. Reported here are nine new records for Bihar and Orissa. Occurrence of *Justicia nilgherrensis* Wall. ex T. And. in Orissa is of particular interest as it extends the distribution of the species from south, towards eastern India.

Cassia hirsuta Linn.

Koraput near Machkund on rocky ground, fl. & fr. 26-x-70. *Yoganarsimhan* 90.

Distribution: Introduced and run wild in many parts of Deccan, Madras, Mysore.—Native of tropical America.

Crotalaria nana Burm. (Fl. Brit. India 2: 71 pp.

Jambu, in grassland, fr. 9-iii-73. *Saxena* 1313.

Distribution: W. Coast, W. Ghats and Karnatak.

Euphorbia prostrata Ait.

Mayurbhanj: Simlipal, a weed, fl. & fr. 24-iv-72. *Saxena* 447.

Distribution: Deccan, Karnatak.—Native of W. Africa and Mauritius.

Hibiscus prainii Raizada & Chatt.

Local name: Halbali, Beniya.

Jambu, common in tidal forests, fl. & fr. 9-iii-73. *Saxena* 1321.

Distribution: Sunderban in West Bengal.

Justicia nilgherrensis Wall. ex T. And.

A small herb or undershrub with characteristic tubercled-glochidiate seeds.

Mayurbhanj: Simplipal, in open places near the forest, fl. & fr. 24-iv-72. *Saxena* 454.

Distribution: Karnatak, Melpat, S. Arcot, W. Ghats, Nilgiris upto 1800 metres.

Merremia aegyptia Urb.

Syn. *Ipomoea pentaphylla* Jacq.

Ganjam: Gadgal fall, fl. 2-xi-1973. *Saxena* 1206, 1207.

Distribution: Western India, West Deccan Peninsula.—Africa, Polynesia, Tropical America.

Rothia indica (Linn.) Druce

Paradeep, on sandy sea coast, fl. 1-i-74. *Saxena* 1484.

Ganjam: Chandiput, in forest, fr. 6-xi-73. *Saxena* 1444.

Distribution: Tropical Plains from Bundelkhand to Sri Lanka.—Australia.

Synedrella nodiflora Gaertn.

Ganjam: Taptapani, along a stream, fl. 7-xi-73. *Saxena* 1466.

Distribution: Assam, Martaban, Andaman Islands.—Tropical America, introduced from Mexico.

Tylophora tenuis Blume

Kujang, climbing over chrubs in tidal forests, fl. 17-iv-73. *Saxena* 1005.

Distribution: Bengal, Deccan Peninsula from Kanara southwards.—Burma, Malacca, Sri Lanka, Java, Borneo.

ACKNOWLEDGEMENT

I am grateful to the Director, Regional Research Laboratory, Bhubaneswar and to Dr. P. K. Dutta, Project Coordinator for facilities. Thanks are due to the Director, Botanical Survey of India, Calcutta and to the staff of the Central National Herbarium, Sibpur, Howrah for their cooperation and the facilities provided for consulting the Herbarium.

REGIONAL RESEARCH LABORATORY,
BHUBANESWAR,
August 23, 1975.

H. O. SAXENA

22. *EUPATORIUM ERYTHROPAPPUM* ROBINSON—A NEW RECORD FOR INDIA

(*With a text-figure*)

During an identification programme we came across some specimens of the taxon *Eupatorium* which appeared after critical study based on available literature and herbarium specimens preserved in the Central National Herbarium (CAL) to be new to Indian flora. The specimen under study was indentified as *Eupatorium erythropappum* Robinson (Compositae). As there is no description in any of the standard floras of India, a detailed description along with an illustrative diagram, place of occurrence, distribution and field notes are given.

Eupatorium erythropappum Robinson in Proc. Bost. Soc. Nat. Hist. 31(6): 248, 1904.

Shrub: Stems minutely glandular pulveru-

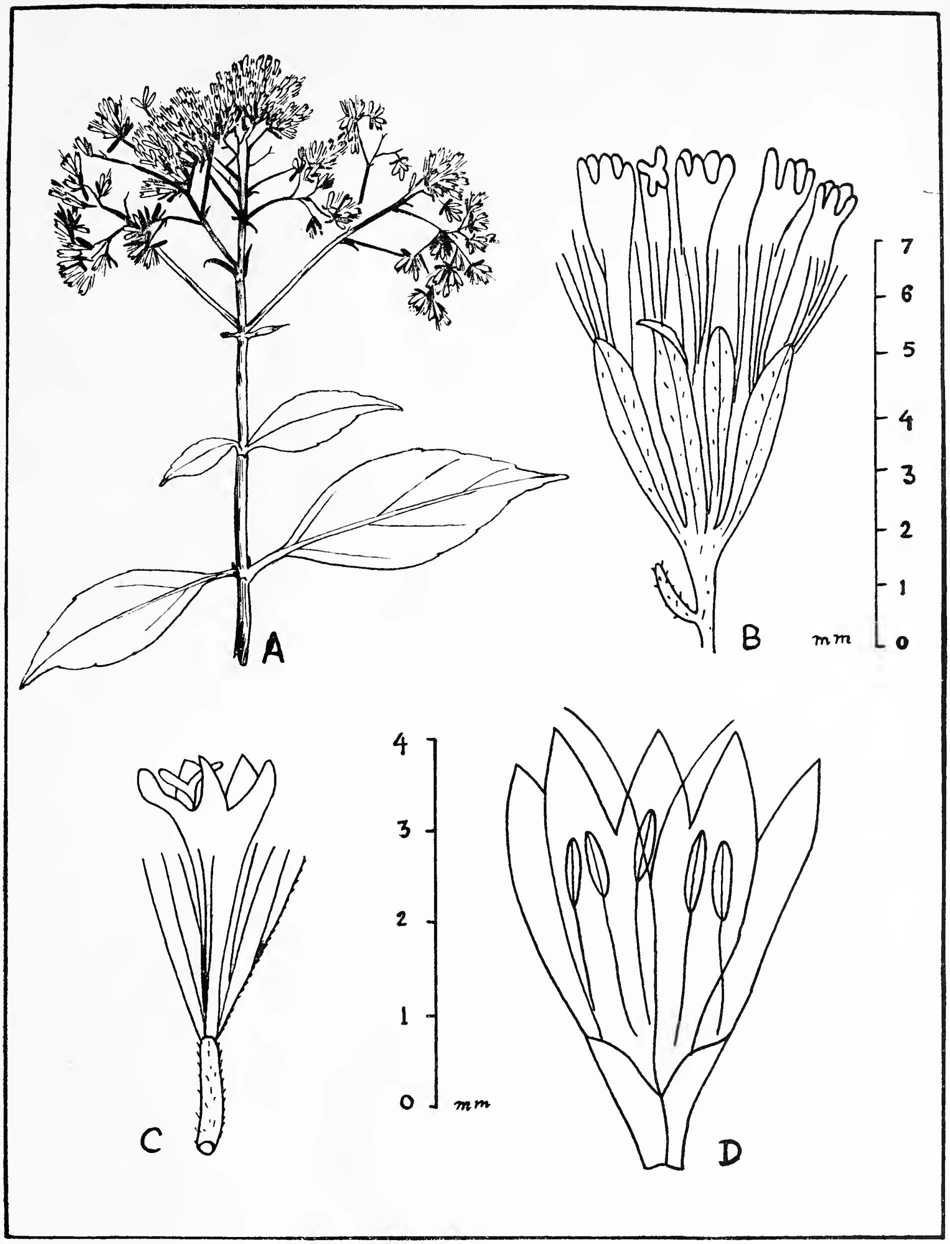

Fig. 1. *Eupatorium erythropappum* Robinson
A. Twig; B. Capitulum; C. Flower; D. Flower split open showing stamens and pistil.

lent. Leaves: 2.5-5.5 × 1-2.2 cm, opposite decussate, obovate, coriaceous, glabrous, acute at apex, alternate at base, margins serrated, lateral nerves 3 on either side of the midrib. Bracts 2, spathulate 5 × 1.5-20 × 3 mm, lower ones lanceolate, upper ones linear, shorter. Flowers in 7.5-8 cm long in terminal corymb. Sapitulum 6-7 mm long, involucral bracts 8-9, unequal, 3-4 mm long, linear oblong, rounded at apex, pubescent. Pappus many, reddish, hairy, (microscopic 10 x). Petals 5-lobed, 5 mm long, white, lobes acute or obtuse at apex. Stamens 5, 3 mm long, filament adnate to the base of petals, anthers hyaline, basifixed. Ovary 2 mm long, linear, faintly angular, silky hairy; style 5.5-6 mm long, bipartite, stigma linear. Fruits: achenes 3 mm long, black, hispid.

Flowers and Fruits: November-January.

Locality: WEST BENGAL: Darjeeling dt., Nov. 1971, *A. K. Mitra,* 55 (A-G) deposited in the Herbarium (CAL).

Field Notes: A mesophytic shrub.

Distribution: Mexico.

ACKNOWLEDGEMENTS

We wish to express our sincere thanks and gratitude to Dr. R. S. Rao, Deputy Director, and Dr. M. P. Nayar, Central National Herbarium, Botanical Survey of India for encouragement, guidance and various facilities for this investigation.

BOTANICAL SURVEY OF INDIA,
INDIAN BOTANIC GARDEN,
CALCUTTA,
May 13, 1975.

R. B. GHOSH
R. N. BANERJEE
A. K. GHOSH

23. *CANSCORA SESSILIFLORA* ROEM. & SCH.—EXTENSION OF GEOGRAPHICAL RANGE
(*With a text-figure*)

C. B. Clarke (1883) in Hooker's FLORA OF BRITISH INDIA 4:104, noted this species from S. Deccan Peninsula; Ceylon. J. S. Gamble (1923) in his FLORA OF THE PRESIDENCY OF MADRAS listed it, 2:618 (rep. ed. 1957) from N. Circars and Carnatic, westwards to the foot of the Madura Hills, in moist places. S. K. Malhotra & S. Moorthy (1973) in *Journal, Bombay nat. Hist. Soc. 70*:600, recorded it from Aksapur, Chandrapur Dist., Maharashtra State.

The species described by Roem. & Sch. (1818) Syst. 3. Monat. 230, apparently remained, *endemic* to southern parts of India for several decades. Th. Cooke (1901-08) did not mention it in his FLORA OF THE PRESIDENCY OF BOMBAY. It is nearly after about a century that the species has, in recent years, extended its geographical range in Western India. I collected the plant from the ravine area of Por, on the bank of a rivulet, Dist. Baroda, Gujarat State, on 2nd March 1975, and the collection is presented here, with a line drawing, to help taxonomic workers to note the occurrence and spread of the species in different parts of the country.

Erect herbs about 50 cm tall; stems 4-winged, continued into the inflorescence. Leaves

Fig. 1. *Canscora sessiliflora* Roem. & Sch., part of the herb and flower.

sessile, ovate, obtuse or subacute. Flowers rosy in colour; pedicels of central flower O, of others short and winged or O (Fig. 1).

The specimens *Oza* 231975, 331975, have been deposited in the Blatter Herbarium (BLAT) of St. Xavier's College, Bombay.

ACKNOWLEDGEMENTS

Grateful thanks are due to Dr. S. K. Mukerjee, F.L.S., of Howrah, for helping with the determination of the plant; the identity was established in the Central National Herbarium (CAL) of the Botanical Survey of India, Calcutta. The line drawing has been prepared by Artist Jade of the Drugs Laboratory, Baroda, to whom I owe debt of gratitude.

GENERAL EDUCATION CENTRE,
MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA,
BARODA 390 002,
June 3, 1975.

G. M. OZA

24. THE OCCURRENCE OF *PHALARIS MINOR* RETZ. IN MAHARASHTRA STATE

A weed having some characters similar to bajra and some to wheat, was located on the farm of the College of Agriculture, Pune, by us. It can be easily mistaken to be a mutant of bajra or wheat. It is commonly known as *chiria-bajra* or Duthie grass and is used as fodder *Phalaris minor* Retzius (1784) is one of the five species of the sub-tribe Phalaridae Kunth, and is distributed in the Mediterranean region and Baluchistan.

As described by Hooker (1896) its stem is 1 to 3 feet long, slender and hollow; leaves long narrow with festucoid anatomy, and oblong silica cells; ligules membraneous, linear, acuminate; sheath smooth. Panicles small and ovoid, longer and cylindric $1\frac{1}{2}$ inches and $2\frac{1}{2}$ inches long by $\frac{3}{4}$ inch diameter, green, spikelet 1/5th long, very shortly pedicelled, shiny.

The species with $2n = 28$ chromosome is an annual with spikelets all similar, lower reduced, hermaphrodite, strongly compressed three flowered with the two lower florets, barren and reduce to the lemmas or one or both absent; rhachilla disarticulating above glume but not above the florets; glumes persistent, equal and as long as the spikelet; lower two lemmas small, sometimes reduced to minute scales fertile lemma becoming indurated, awnless five nerved; palea as long as the lemma, two nerved, two keeled. Loducles two; stigmas two; stamens three. Grain closely invested by the indurated lemma and palea, hilum oblong, short, embryo small; starch grain compound; wings of the glumes minutely serrate and undulate, sterile lemmas are very dissimilar, the lower very minute, the upper about one-third of the spikelet (Kunth 1829-34).

The species is resistant to diseases under field conditions and could be used in improving related grasses. In addition to Pune region the species also was seen last year in Nasik and Satara districts. It might have been introduced in Maharashtra as an adulterant

in wheat as it was found to be quite vigorous in rabi season.

The meiotic studies of the plant showed slight irregular behaviour of chromosomes. The bridges, laggards and tetrads with micronuclei were also observed. Multivalents at metaphase-I were also recorded and this may be due to the allosyndetic pairing of the chromosomes. From the meiotic behaviour of this species, it may be presumed that it may have originated from two allied groups having $2n = 14$ chromosomes and subsequent diplodisation.

A specimen of the species has been deposited in Botanical Survey of India, Pune.

BOTANY DEPARTMENT,
COLLEGE OF AGRICULTURE,
PUNE 411 005,
July 4, 1975.

S. D. UGALE
R. C. PATIL

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25. *ISOETES* IN RAJASTHAN
(*With a plate*)

Two new forms of *Isoetes* have been discovered in South East Rajasthan since the genus was first recorded in 1969 from Mt. Abu in South West Rajasthan. Morphological features of all the Rajasthan forms of *Isoetes* are described and comparisons made with seven species of the genus known from India. Dissemination of spores in nature and reproduction in the genus is commented upon in the light of observations made in the field and in the garden. Similarities between *Isoetes* and water fern *Marsilea* in respect of habitat, vegetative reproduction and sporal aberrations are emphasized.

Mital (1969) recorded the occurrence of an *Isoetes* sp. for the first time in Rajasthan from Mt. Abu in his catalogue of the ferns and fern-allies of Rajasthan. Another locality for *Isoetes* —at Atru, a Tehsil about 100 kilometres from Kota in SE. Rajasthan has now been discovered. *Isoetes* was found growing in ponds and ditches just near the Railway line at this locality. Two distinct forms of the genus, one larger with plants measuring upto 45 cm (Fig. 1) and the other with very small plants (upto 6.5 cm) in height grow at this place. The bigger form grows in the ponds and ditches in an aquatic habitat mostly with occasional incursions on land, the smaller form being confined to the drying margins of these ponds and ditches. A preliminary examination of these three *Isoetes* forms of Rajasthan, one at Mt. Abu (Fig. 9) and the other two at Atru (Figs. 1 & 5) from the point of view of specific determination yielded morphological features found in none of the Indian species described so far.

It is possible to distinguish these three *Iso-*

etes forms of Rajasthan from each other as well as from the known Indian species (Pant & Srivastava 1962; Goswami & Arya 1970) on the basis of usual criteria employed for specific determination in this genus. The larger Atru form shows over all resemblance with *Isoetes coromandelina* Linn. in size of plants and megaspore features. However, the presence of two and three-lobed rhizomorphs (Fig. 2) in equal proportions in nature, a well developed upper labium of the velum and complete absence of microspores in the material examined so far are features in which the larger Atru form is different from *I. coromandelina* and *I. indica* Pant and Srivastava. Moreover, the branching of proximal rays in *I. indica* megaspores has not been observed in the megaspores of the larger Atru form.

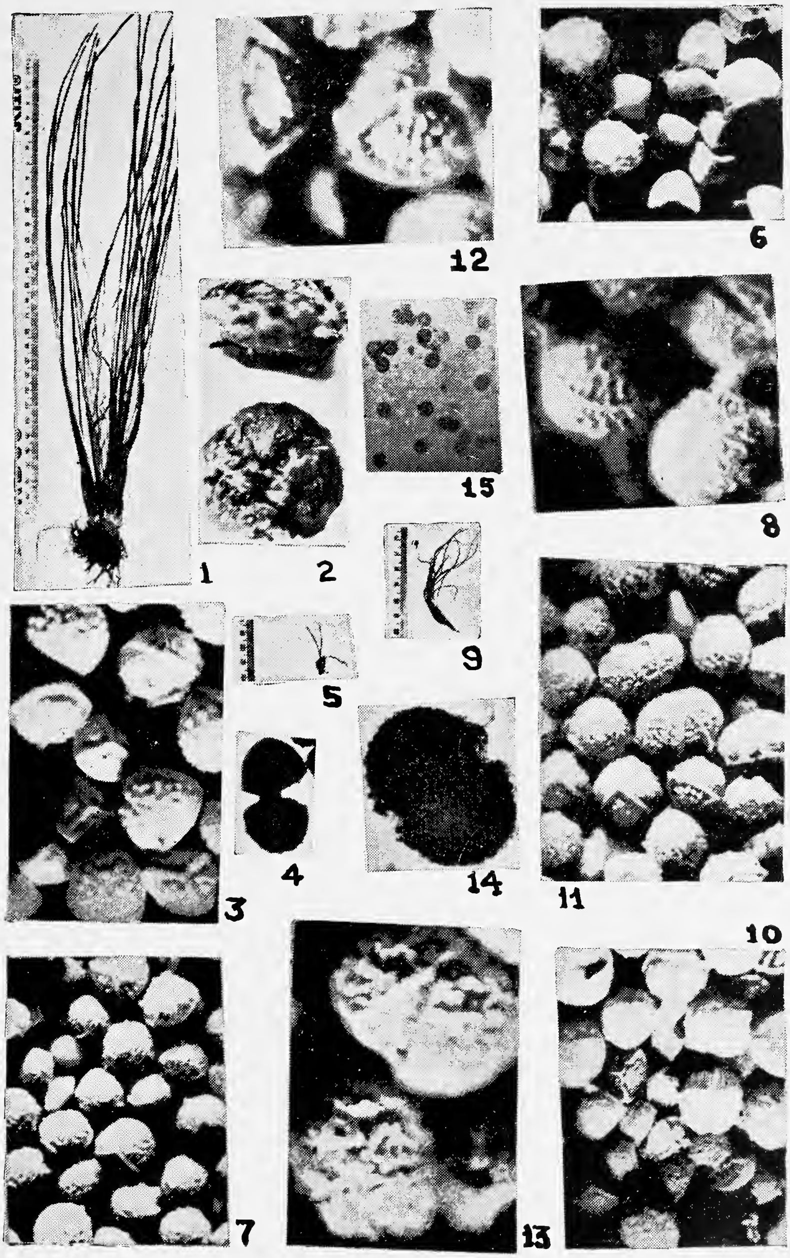
Similarly the smaller Atru *Isoetes* seems to resemble *I. sampathkumaranii* Rao in rhizomorph lobes, velum, megaspore characters and complete absence of microspores. The presence of tubercles on the proximal side and the slightly wavy proximal rays of small megaspores (Fig. 6) however, are features in this Atru form which distinguished it from *I. sampathkumaranii*. On comparison with *I. dixitei* Shende the smaller Atru *Isoetes* is again found to be different as the former lacks a velum and possesses megaspores with tuberculated surface whereas in the latter a velum is present and the megaspores have mostly reticulated surface with few round tubercles (Figs. 6 and 7).

Isoetes from Abu is distinctive in possessing trimorphic megaspores with medium sized megaspores showing distinctly wavy proximal rays (Fig. 10) when it is compared with the other two forms of the genus from Atru, Rajasthan. In this respect it resembles *I. indica* but the latter is a much bigger plant (upto 56 cm) and is velumless whereas in the Abu form a distinct velum covering almost two-thirds of the megasporangium is present. Another characteristic feature of the Abu form is the great frequency of fused megaspores (Figs. 11 & 13). In this respect as well as in the possession of trimorphic megaspores it resembles *I. pantii* described by Goswami & Arya (1970) from Narsingarh, Madhya Pradesh. It may be mentioned here that all the united megaspores in the Abu form seem to be fused bodily (Figs. 13 & 14) like the one seen in *I. pantii* figured by Goswami & Arya (1970). In the rare united megaspores observed by us in the larger Atru form the two united megaspores are only joined by a narrow bridge (Fig. 4). *I. pantii* again is a velumless Indian species of the genus and thus different from the Abu form in this respect.

Isoetes is a difficult genus taxonomically and inspite of the distinctive features of the three Rajasthan forms of the genus we cannot at present say if they are new species pending detailed investigations in progress in this laboratory. However, some observations pertinent to the biology and reproduction of the genus in nature are made here.

Dissemination of spores

Pant and Srivastava (1962) substantiate Duthie's observations on African species of *Isoetes* regarding spore dispersal by Earthworms in *Isoetes* plants growing at village Ram Nai, Rewa, Madhya Pradesh. In both the Atru forms however, the megasporangia burst from base to apex after the onset of dry season. Plants with megaspores scattered around on the surface were frequently observed in nature. Earthworms were neither observed in nature nor when the plants were grown in the garden.



(For captions, see overleaf)

Isoetes bigger form—Atru

Figs. 1-4: 1. Plant; 2. two-and three-lobed rhizomorph, *c.* × 2; 3. distal and proximal surface of large and small megaspore respectively, *c.* × 35; 4. megaspores joined by a bridge, *c.* × 35.

Isoetes smaller form—Atru

Figs. 5-8: 5. Plants; 6 and 7. dimorphic megaspores showing distal and proximal surface, *c.* × 35; 8. megaspore surface (higher magnification) showing reticulations and few tubercles, lateral view, *c.* × 100.

Isoetes form—Abu

Figs. 9-15: 9. Plant; 10 and 11. Trimorphic and fused megaspores showing distal, proximal and lateral surfaces. Note distinctly wavy nature of medium sized megaspores in fig. 10, *c.* × 35; 12. small megaspore, proximal surface showing straight proximal rays and round tubercles on pyramidal region *c.* × 100; 13. fused megaspores, distal surface showing reticulation and few round tubercles *c.* × 100; 14. two fused megaspores in reflected light, *c.* × 90; 15. microspores *c.* × 90.

Contiguous occurrence of the two forms of *Isoetes* at Atru

Pant and Srivastava found *I. coromandelina*, *I. indica* and *I. panchananii* growing together at village Ram Nai in Madhya Pradesh. Similarly the larger and smaller forms of *Isoetes* at Atru grow contiguously. However, instead of growing intermixed the bigger form at Atru grows generally inside the ponds and ditches in an aquatic habitat while the smaller form occupies only the drying margins of these ponds and ditches. Further in contrast to the bigger *I. coromandelina* and *I. indica* at Ram Nai which mature early both the larger and smaller forms at Atru mature almost at the same time. In contrast to the smaller *I. panchananii* at Ram Nai the smaller *Isoetes* at Atru disappears early, the larger form continuing to grow till the water dries up completely.

Reproduction in *Isoetes*

Rare occurrence of microsporophylls and microspores in natural populations of the genus in India as reported in the literature (Verma 1960; Bhambie 1963) and the presence of spore polymorphism including enucleate spores raises interesting questions regarding mechanism of reproduction in the genus. Bhambie (1963) suggests *I. coromandelina* could be an apogamous species. Pant & Srivastava (1965) suppose that the more common method of reproduction in the Indian species of *Isoetes* may be vegetative. This is fully borne out by our observations of the Rajasthan material both in nature and in cultivation. We found that the dried up corms of a previous season sprout up again during next rainy season at Atru. The same thing has been observed in plants grown in the garden for the past three years. As far as known to us this fact has not been mentioned in the literature. The megasporal polymorphism, joined and fused spores, enucleate spores and related spore abnormalities draw attention to the situation prevailing in the heterosporous fern *Marsilea*. Both these genera are heterosporous with basically identical ecological patterns of growth, being aquatic as well as terrestrial. Both seem to depend largely on vegetative propagation. In *Marsilea* sexual reproduction is of very limited occurrence in nature. So much so that certain populations in the genus produce abnormal sporocarps containing non-viable aberrant spores. The microsporangia of certain species like *Marsilea rajasthanensis* Gupta contain a variable number of polymorphic spores (Gupta 1962; Bhardwaja 1966). Besides quite a good number of *Marsilea* species produce parthenogenetic plants (Bhardwaja & Abdullah 1972). Parthenogenesis in *Isoetes* has been observed by Pant and Srivastava (1965) who found that only bigger megaspores with full chromosome complement in nature and the laboratory. Recently Goswami (1975) also reports apogamous germination of spores in *I. pantii*. The extent of parallelism shown by *Isoetes* and *Marsilea* in habitat, vegetative propagation and sporal aberrations however, is significant. It is this fact which makes it difficult to identify dependable criteria for interspecific delimitations in both these genera.

Acknowledgements

Grateful thanks are due to Principal N. M. Kothari and Prof. A. N. Parashar, Government College, Ajmer for laboratory facilities and encouragement. Prof. H. S. Saxena, Principal, Government College, Bundi (Rajasthan) and kind enough to provide facilities for field and laboratory work to one of us (C. B. Gena).

GOVERNMENT COLLEGE,
BUNDI.

GOVERNMENT COLLEGE,
AJMER,
February 3, 1975.

C. B. GENA
P. L. MITAL
T. N. BHARDWAJA

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26. *ROSENSCHELDIELLA ORBIS* (BERK.) PETR., AND *SCLEROTIOPSIS CONCAVA* (DUM.) SHEAR & DODGE, NEW RECORDS FOR INDIA

INTRODUCTION

During the course of a mycological survey of the forests of South-West India (Kanyakumari to Bombay through Karnataka) two interesting and are follicolous fungi, hitherto unreported from India were collected. One of these belonged to the Dothidiaceous genus, *Rosenscheldiella* Theiss. & Sydow [*R. orbis* (Berk.) Petr.] and the other, to the form-genus, *Sclerotiopsis* [*S. concava* (Dum.) Shear & Dodge] (Fam. Leptostromataceae). These two collections are described.

DESCRIPTION

1. *Rosenscheldiella* Theissen & Sydow

This genus was established by Theissen & Sydow (1915) for a Dothidiaceous fungus with *R. styracis* (P. Henn.) Theiss. & Syd. as the type collected on the leaves of *Styrax* sp. (Fam. Styraceae) from Brazil. No member of the genus was known from India until Ananthanarayanan (1962) reported the occurrence of *R. eugeniae* Petch causing tar-spot disease in *Eugenia heyneana* Duth. (Fam. Myrtaceae) from Maharashtra State. Later, Muthappa (1967) described *R. cinnamomi* Muth., parasitizing leaves of *Cinnamomum zeylanicum* Bl. (Fam. Lauraceae) collected from Coorg forests of Karnataka.

As early as 1921, (Sydow 1921) reported a fungus similar to the present collection on the leaves of *Litsea glauca* Siebold from Ceylon and named it *R. litsea* Syd. Later, Petrak

(1941) listed it as a synonym to *R. orbis* (Berk.) Petr.

1. **Rosenscheldiella orbis** (Berk.) Petr.

Stroma hypophyllous, aggregate, minute, slightly raised, multi-loculate, measure 0.5-1 mm in diam. Locules globular to oval, non-ostiolate measure 68-102 × 42.5-68 μ, asci fasciculate, slightly clavate, bitunicate, apex rounded, 8-spored, aparaphysate, measure 38-60.8 × 9.5-19 μ; ascospores hyaline, 2-celled, slightly bent, with rounded ends, 13.3-15.2 × 3.8-5.7 μ.

This fungus was on the dried, dechlorophylled leaves of *Litsea coriacea* Hook. (Fam. Lauraceae), collected at Ponmudi forests of Trivandrum (Kerala State) on 28-ix-1973 and has been deposited at the Ajrekar Mycological Herbarium (AMH) of this Institute under No. AMH 2519.

Remarks: It is interesting to note that this fungus was collected on the same host-genus, namely *Litsea,* also reported earlier from Sri Lanka (Ceylon) with no significant variations (Table 1). Again, its collection in India, in close geographical proximity to Ceylon is of ecological interest.

TABLE 1

Rosenscheldiella orbis (BERK.) PETR. ON *Litsea* SP.

Species :	Ascostromate :	Locules :	Asci :	Ascospores :	Authority
Rosenscheldiella litseae Sydow	0.5-2 mm	60-88 x 60-75μ	38-60 x 15-20μ	15-20 x 4-4.5μ	Sydow.1921
R. orbis (Berk.) Petr.	—	50-80μ	40-60 x 15-20μ	15-20 x 4-6μ	Petrak, 1941
R. orbis (Berk.) Petr. (Indian collection)	0.5-1.5 mm	68-102 x 42.5-68μ	38-60 x 9.5-19μ	13.3-15.2 x 3.8-5.7μ	,, ,,

2. *Sclerotiopsis* Speg.

This genus was established by Spegazzini (1880) for a pycnidial fungus with hemispherical, non-ostiolate, black, raised fructifications which are sclerotic with fusoid to cylindrical or navicular, lunate or curved, hyaline unicellular spores arising acrogenously from dense, erect, crowded, unbranched conidiophores. The fungus material was collected on the leaves of *Eucalyptus globulus* Labill. (Fam. Myrtaceae) from Argentina with *S. australasica* Speg. as the type.

Desmaziers (1847) reported a closely similar fungus and assigned it to *Ceuthospora concava* Dum. growing saprophytically on the leaves of *Rosa* sp. from France. Shear & Dodge (1921) assigned the fungus causing post-harvest rot of strawberries to *Sclerotiopsis concava* (Dum.) Shear & Dodge (using the specific epithet *concava* because of its earlier chronology). By doing so, Spegazzini's *S. australasica* (which is the type) has been emmended to be a synonym to *S. concava* (Dum.) Shear & Dodge.

No member of this genus was known from India, until Ramakrishnan (1952) reported *Sclerotiopsis indica* Ramakr. parasitizing leaves of *Ilex wightiana* Wall. (Fam. Aquifoliaceae) from South India. Later, Garud (1970) described *S. microspora* Garud on the leaves of *Acacia auriculiformis* L. from Maharashtra. These are the only two known species from India.

The present collection is from the leaves of *Eucalyptus globulus* Labill. collected at forests near Devikulam (Kerala State) on

24-ix-1973. Our collection was identified as *S. concava* after a detailed study and the material has been deposited at the AMH under No. 2518.

2. **Schlerotiopsis concava** (Dum.) Shear & Dodge

Pycnostroma epiphyllous, raised, non-ostiolate, 1-2 mm diam., inner content parenchymatous uniloculate with an inner lining of dense erect crowded and unbranched conidiophores measuring 28.5-41.8 × 2 μ; conidia concave, navicular, apex rounded (not acute), hyaline, one-celled, measure, 9.5-15.2 × 1.7-2 μ.

ACKNOWLEDGEMENTS

We are very grateful to Professor M. N. Kamat for his valuable suggestions and interest and to the Director, M.A.C.S., Poona 4, for laboratory and literature facilities. Thanks are also due to the Government of India for financial assistance to one of us (V.S.).

MAHARASHTRA ASSOCIATION FOR THE CULTIVATION OF SCIENCE,
PUNE 411 004,
August 23, 1975.

V. SUBRAMONIAM
V. G. RAO

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ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR 1975-76

EXECUTIVE COMMITTEE

President

Dr. Sálim Ali, D.S.C., F.N.A.

Vice-Presidents

Mr. R. E. Hawkins
Mr. G. V. Bedekar, I.C.S. (Retd.)

Hon. Secretary

Dr. A. N. D. Nanavati, M.D.

Hon. Treasurer

Dr. C. V. Kulkarni, M.SC., Ph.D.

Member

Secretary, Ministry of Education,
Govt. of India

Ex-officio

Elected Members

Dr. S. R. Amladi, M.D.
Prof. P. V. Bole
Dr. B. Dasgupta
Mr. H. K. Divekar
Mr. Lavkumar J. Khacher
Mr. Nazir Latif
Mr. Bansi Mehta
Mr. Kisan Mehta
Mr. S. V. Nilakanta
Mr. D. J. Panday

ADVISORY COMMITTEE

Mr. H. G. Acharya	*Ahmedabad*
Mr. F. C. Badhwar, O.B.E.	*New Delhi*
Dr. B. Biswas	*Calcutta*
Mr. S. Chaudhuri	*New Delhi*
Dr. Chintaman Deshmukh, I.C.S. (Retd.)	*Hyderabad*
Mr. Zafar Futehally	*Bangalore*
Mr. Shivrajkumar Khachar	*Jasdan*
Mr. M. Krishnan	*Madras*
Mr. Duleep Matthai	*New Delhi*
Mr. Ranjit Sinh, I.A.S.	*New Delhi*

HONORARY SECRETARY'S REPORT FOR THE YEAR 1975

This report covers the activities of the Society in the 92nd year of its existence.

MEMBERSHIP

This is the first year of report after the enhanced subscription which was necessary to meet the increased administrative and other costs. We are gratified by the continued support extended by our members. The number of Life and ordinary members, the backbone of the Society, has in total—deviated little from the last years figures, 966 as against 995 in 1975.

	1972	1973	1974	1975	1976
Ordinary Members	780	801	770	763	719

The number of other classes of members are given below:

	1972	1973	1974	1975	1976
Life Members	181	187	198	232	247
Student Members	5	9	16	20	19
Honorary Members	3	3	4	4	4
Forest Department Nominees	80	89	90	90	36

There is no cause of complacency and recruiting more members should be first charge of our active members.

ACTIVITIES

PUBLICATIONS

The *Journal* unfortunately continues to lag. Owing to printing delays only two issues of the journal bear the year's date. The August issue for 1974 and the April issue for 1975. The December 1974 issue, the Sálim Ali Feschrift number and the journals for 1975 were delayed. Among these the December 1974, Vol. 71(3) and the issue for 1975, Vol. 72 (1, 2) have since been published.

The articles continued to cover a wide range of subjects with emphasis on the ecology, behaviour, and taxonomy of Indian fauna and the taxonomy and regional lists of Indian flora.

Books: During the year following sales were made:

	Sale	*Balance Stock*
BOOK OF INDIAN BIRDS	1634	590
BOOK OF INDIAN ANIMALS	662	1335
SNAKE CHARTS	43	887
CHECKLIST OF THE BIRDS OF MAHARASHTRA	60	589
GLIMPSES OF NATURE IN INDIA BOOKLET	172	2937

The question of printing a revised 2nd edition of the SYNOPSIS OF THE BIRDS OF INDIA is under active consideration. The Government of India has been asked for assistance to reprint out-of-print books.

Nature Calendar: The 1975 Nature Calendar was awarded a prize for excellence in printing. The calendar continues to be popular with members and a source of income to the Society.

Conservation

The Society continued to take a leading part in the conservation movement in the country through its representatives on the State and Central Wildlife Boards, and through its members on the International Union for Conservation of Nature and Natural Resources, the World Wildlife Fund, and the International Council for Bird Preservation.

Member Activities

It has been possible to involve members in Bombay in local field activities.

Borivli National Park Project: With the assistance of interested members an attempt was made during the year to record the changes in the vegetation, animal life and other natural phenomena in a small valley in the Borivli National Park close to Bombay. The programme was primarily an exercise in training in scientific observation. The activity is being continued.

Bird Count: A monthly roadside count of birds in the Borivli National Park was organised with the assistance of members. The activity received financial assistance from the Sálim Ali-Loke Ornithological Research Fund. The activity is being continued.

Nature Walks: Nature Walks were organised in Borivli National Park for birdwatching and for study of the vegetation. A large number of members participated.

Photographic Cell: Amateur Nature Photographers among the members held meetings to discuss methods and see photographs taken by members.

Research and Field Studies

Sálim Ali-Loke Wan Tho Ornithological Research Fund: The Fund continued to support with a fellowship, Mr M. A. Reza Khan who is investigating the ecology of the Black and Orange flycatcher of South India.

A felliowship was awarded to Mr Zacharias of Calicut University, Kerala. Mr Zacharias will study the ecology and biology of Babblers under the guidance of Dr D. N. Mathew.

The fund also extended support to the organisation of a monthly bird census at Borivli National Park.

The Migration Study: The Government of India approved our proposal for computer analysis of the data collected under the migration study project. Financial assistance has been sanctioned and the project will be undertaken in collaboration with Dr M. Gadgil of the Indian Institute of Science.

Kaziranga Bird Camp: At the instance and with financial and other assistance from the Forest Department of Assam a banding camp was organised at the Kaziranga National Park. The effort was not successful as work at night was not possible owing to interference from elephants and rhinoceros.

Hingolgadh Migration Study: A fortnights migration study camp was held at Hingolgadh at Jasdan, Gujarat, for training local students in bird study.

University Department: Mr. R. B. Grubh, senior Research Assistant at the Society was awarded the Ph.D. in field Ornithology of the Bombay University for his thesis on the "Ecology of Vultures of the Gir Forest".

During the year the Society had two students registered for Ph.D. under Dr Sálim Ali's guidance and two students for M.Sc. under Mr J. C. Daniel.

Orissa Bird Survey: Dr Sálim Ali, accompanied by Dr. Dillon Ripley, Secretary, Smithsonian Institution and members of the Society's staff surveyed areas in Orissa and Andhra Pradesh in search of the rare Blewitt's Owl

and Jerdon's Courser. Though not successful in their main enquiry the survey party brought several interesting additions to the Research Collections.

Nilgiris: A small collection of bird was obtained from the Nilgiris by Mr Humayun Abdulali with financial assistance from the Charles McCann Field Work Fund.

Pudukottai Gazetteer: At the instance of the Government of Tamil Nadu the birds of Pudukottai District in that state was surveyed by Dr Sálim Ali assisted by the Society's staff and notes were prepared for the Ornithology section of the District Gazetteer.

Herpetological Survey: The herpetology of the Malabar District of Kerala was surveyed and interesting additions including type locality material was added to the Society's collections.

Borivli National Park: With the active assistance of its local members and other organisations the Society was able to convince Goverment that it would be highly detrimental to run a highway through a section of the Park. The Chief Minister and his colleagues in Government deserve the thanks of all conservationists for deciding to realign the road.

Kinwat Survey: At the instance of the local Member of Legislative Council, the Kinwat forest areas were visited again by M/s J. C. Daniel, S. R. Amladi, and S. A. Hussain to examine the areas' potential for wild life conservation. Financial support was received from the World Wildlife Fund.

Jayakwadi Project area Survey: The Honorary Secretary and Dr S. R. Amladi assisted by the Curator visited the Jayakwadi Project area to investigate possible areas for monitoring effects of the Dam on the environment. The survey was financed by the World Wildlife Fund.

Jerdon's Courser Pamphlet: As a follow up of the Orissa Survey a pamphlet with colour pictures of the Common & Jerdon's Courser was prepared with financial assistance from the Sálim Ali-Loke Wan Tho Ornithological Research Fund. The pamphlet was circulated through the forest departments in likely habitats of the species.

Field Work Awards

Dorabji Tata Field Work Fund: A grant was made from the fund to Miss Anuradha of Bangalore University to study the ecology of the little known Opilionid arachnids, commonly known as Harvestmen.

Charles McCann Field Work Fund: A grant was made to Dr Andrews of Marthoma College, Kerala for studying the food habits of the commercially important bull frogs of his area.

Donations

Film on Baobab Tree: We are deeply indebted to Dr Dillon Ripley and the Smithsonian Institution for the donation to the Society of this excellent film to assist in the fund raising activities of the Society. The film is being censored and prepared for use.

Binoculars: We are grateful to Mr C. C. Adenwalla for the donation of a pair of binoculars suitable for use at night.

Jerdon's Courser Painting: We are grateful to Mr J. P. Irani for donating a painting of the Courser for use by the Society for a pamphlet on the bird to aid its rediscovery.

We are grateful to members and others for the following donations:

Charles McCann Field Work Fund:

1. Mr S. Chaudhari	600.00	
2. Mr Bansi Mehta	25.00	
3. From a well wisher	250.00	875.00
World Wildlife Fund	6000.00	
Dr Sálim Ali	2000.00	
Other donations	105.00	8,105.00
Mr H. K. Divekar for Library		500.00
Pirojsha Godrej Foundation		10,000.00

Grants

Grant from Government of Maharashtra for establishment expenses, printing, and nature education activities and building maintenance.	82,049.00
Grant from Government of India for Journal	20,000.00
Plan Expenditure (Publication) (Government of India)	40,000.00

Meetings

January:

Two films were shown: "Lokande Wilderness" and "In Company of Birds".

April:

Mr J. C. Gouldsbury spoke on "Experiences of Wildlife Management in South India" on 4th April 1975.

Release of Bird Stamps on 28th April 1975.

Mr S. R. Nayak showed slides on Natural History subjects on 28th April.

May:

Prof. Steven Green spoke on "Lion-tailed Monkeys and their rainforest habitat in the Western Ghats" on 21st May 1975.

July:

Br Navarro spoke on "Bird calls from the Western Ghats" on 31st July 1975.

Reference Collection

During the year 562 specimens were received at the Society.

Mammals	4
Birds	282
Reptiles	90
Amphibians	186

Important additions are:

Birds: *Sturnus burmanicus*
Emberiza citrinella

Reptiles: *Cnemaspis littoralis*
Ristella guentheri
Cyrtodactylus collegalensis
Coll: P. B. Shekar

Nature Education Scheme

28 field trips were arranged to Borivli National Park for school students and trainee teachers. 52 schools were visited personally

by the Nature Education Organiser, during the year and about 400 schools were contacted from time to time through circulars.

Guidance was given to 11 schools in preparing projects on common birds, plants, trees and butterflies and other insects for exhibitions. Three Radio programmes on nature education (with school children) were given during the year. A T.V. programme on nature education was given in June. 17 schools were taken to Prince of Wales Museum, 5 Victoria Garden and 3 to Taraporewala Aquarium. Silkworm caterpillars were distributed to the schools.

Nature Education was introduced to the students of Sriharikota Students (Andhra Pradesh).

Library

During the year 348 books were added to the Library, of which 23 were purchased, 314 donated and 11 received as review copies for the Journal. The total number of books and bound periodicals in the library is over 8000 and includes many rare and out-of-print volumes on Indian natural history. We are grateful to the donors, particularly to Dr S. S. Kalbag and the trustees of the Estate of the late Loke Wan Tho.

Revenue and Accounts

The financial situation of the Society continued to be unsatisfactory. The year's operation showed a small surplus.

Staff

The Committee wishes to record its appreciation of the willing co-operation of the staff in the activities of the Society.

Acknowledgements

The Society thanks the following persons and organizations for the cooperation and generous assistance in various ways.

1. Godrej Foundation, World Wildlife Fund – India and Dr Sálim Ali for financial assistance.
2. The Divisional Forest Officer, Borivli and the Forest Department for facilities to assist in tree-planting campaign.
3. Smithsonian Institution and Dr S. Dillon Ripley for printing and donating to the Society 750 copies of the Synopsis of the Birds of Indian Region.
4. The Government of Maharashtra and the Government of India for their continued support, financial and other.
5. The German Consulate, USIS, British Council, French Consulate for providing on loan excellent wildlife movies.

Registered No. F. 244 (BOM)

BOMBAY NATURAL HISTORY SOCIETY

THE BOMBAY PUBLIC TRUST ACT, 1950
SCHEDULE VII [VIDE RULE 17(1)]

BALANCE SHEET FOR THE YEAR ENDED 31 DECEMBER 1975

FUNDS AND LIABILITIES

	Rs. P.	Rs. P.
Trust Funds of Corpus:		
Life Membership fund:		
Balance as per last Balance Sheet	87,377.76	
Add: Amount received during the year	9,269.85	96,647.61
Fixed Assets Fund:		
Balance as per last Balance Sheet	1,11,228.35	
Add: Value of fixed assets purchased during the year from Government of India grant	5,374.84	
	1,16,603.19	
Less: Transferred to Income and Expenditure account on account of depreciation for the year	17,315.43	99,287.76
General Reserve Fund:		
Balance as per last Balance Sheet		34,015.40
Building Fund:		
Balance as per last Balance Sheet		9,244.68
Publication Fund:		
Balance as per last Balance Sheet	30,725.00	
Add: Sale proceeds from Glimpses of Nature booklets published under W.W.F. Grant	4,991.00	35,716.00
Other Earmarked Funds:		
(As per Schedule 'A')		3,42,005.77
Carried forward		6,16,917.22

ASSETS

	Rs. P.	Rs. P.
Immovable Properties:		Nil
Investments: (At appropriated value)		
50, 8% Convertible bonds each of Rs. 100/ of Ahmedabad Manufacturing & Calico Printing Co. Ltd., fully paid (Market value Rs. 3,500/-)	2,130.20	
202, 8% Redeemable bonds each of Rs. 116/- of Ahmedabad Manufacturing & Calico Printing Co. Ltd., fully paid (Market value Rs. 17,372/-)	9,982.95	
Government Securities: (At cost)		
3% Conversion Loan 1946/86 of the face value of Rs. 25,000/	25,000.00	
5½% Government of India Loan 2000 of the face value of Rs. 2,000/-	2,000.00	39,113.15
Deposit with:		
M/s. Indian Dyestuff Industries Ltd., Bombay (against Dr. Sálim Ali-Loke Wantho Ornithological Research Fund)		1,25,000.00
Motor Cars, Motor Cycles & Auto Cycle:		
Balance as per last Balance Sheet	36,700.38	
Less: Depreciation during the year	7,340.08	29,360.30
Carried forward		1,93,473.45

FUNDS AND LIABILITIES

Brought forward		6,16,917.22
Provision for Capital Losses:		
Balance as per last Balance Sheet		4,528.38
Provision for Depreciation on Investments:		
Balance as per last Balance Sheet		9,266.10
Liabilities:		
For expenses	66,501.34	
For Advance Subscriptions	2,332.25	
For Sundry Credit Balances	26,750.72	95,584.31
Carried forward		7,26,296.01

ASSETS

Brought forward		1,93,473.45
Furniture Fixtures & Equipments:		
Balance as per last Balance Sheet	74,427.97	
Add: Additions during the year	5,374.84	
	79,802.81	
Less: Depreciation during the year	9,975.35	69,827.46
Loans: (Unsecured considered good)		
To employees		335.00
Advances: (Unsecured considered good)		
To employees	894.80	
To others	2,848.34	3,743.14
Stocks: Publications (as per inventory taken and certified by the Curator)		26,521.35
Income Outstanding:		
Interest accrued	16,613.72	
Supplies and Services	49,845.06	66,458.78
Cash and Bank Balances:		
(A) *In current account with*:		
1. Grindlays Bank Ltd., Mahatma Gandhi Rd., Bombay	36,767.35	
2. Grindlays Bank Ltd., London (converted at Rs. 18 = £ 1)	21,119.04	
3. Chartered Bank, Bombay	19,755.01	
(B) *In savings account with*:		
Grindlays Bank Ltd., Mahatma Gandhi Rd., Bombay	369.54	
(C) *In Fixed Deposit with*:		
1. Bank of India, Bombay (consisting of Rs. 36,000/- of Dr. Sálim Ali-Loke Wantho Ornithological Research Fund & Rs. 3,000/- for Col. Burtons Nature Conservation Fund)	39,000.00	
Carried forward	1,17,010.94	3,60,359.18

FUNDS AND LIABILITIES		ASSETS		
Brought forward	7,26,296.01	Brought forward		3,60,359.18
		Cash and Bank Balances (contd.): B./f.	1,17,010.94	
		2. Chartered Bank Bombay (including Rs. 15,000/- of Chas. McCann Vertebrate Zoology field work fund & Rs. 17,000/- for Dr. Sálim Ali-Loke Wantho Ornithological Research Fund)	67,400.00	
		3. Grindlays Bank Ltd., (including Rs. 35,000/- of Dr. Sálim Ali-Loke Wantho Ornithological Research Fund	1,15,000.00	2,99,410.94
		Income and Expenditure Account:		
		Balance as per last Balance Sheet	67,335.64	
		Less: Surplus during the year	809.75	66,525.89
Total	7,26,296.01	Total		7,26,296.01

Sd/- Salim Ali,
President,
Bombay Natural History Society.

Sd/- A N. D. Nanavati,
Honorary Secretary,
Bombay Natural History Society

As per our report of even date
Sd/- Habib & Company
Chartered Accountants.

Sd/- C. V. Kulkarni
Honorary Treasurer,
Bombay Natural History Society

Bombay, 30th August, 1976.

SCHEDULE 'A'

BOMBAY NATURAL HISTORY SOCIETY

SCHEDULE FORMING THE PART OF THE BALANCE SHEET AS AT 31 *DECEMBER*, 1975

Name of the Fund/Grant (1)	*Balance as per last Balance Sheet* (2)	*Additions/ Amounts received during the year* (3)	*Transfers from other Funds* (4)	*Total of columns 2,3, & 4* (5)	*Spent/ refunded during the year* (6)	*Transfers to other Funds* (7)	*Total of columns 6 & 7* (8)	*Balance as at 31st December 1975 (5 minus 8)* (9)
(1) Field Work Fund (Sir Dorabjee Tata Trust)	1,642.64	—	—	1,642.64	1,417.50	—	1,417.50	225.14
(2) Staff Welfare Fund	2,020.69	—	—	2,020.69	—	—	—	2,020.69
(3) Dr. Sálim Ali-Loke Wantho Ornithological Research Fund	2,13,136.52	—	—	2,13,136.52	—	—	—	2,13,136.52
(4) Col. Burton's Nature conservation fund	3,275.34	300.00 (Interest)	—	3,575.34	—	—	—	3,575.34
(5) Charles McCann Vertebrate Zoology field work fund	17,165.97	2,292.60 (including interest Rs. 1,417.60)	—	19,458.57	831.57	—	831.57	18,627.00
(6) Grant Seth Purushottamdas Thakoredas & Divaliba Charitable Trust for the publication of Shri M. Krishnan's Ecological Survey of India	6,201.54	—	—	6,201.54	210.00	—	210.00	5,991.54
(7) Grant from His Majesty King of Bhutan for the publication of "Birds of Bhutan" by Dr. Sálim Ali	5,813.39	—	—	5,813.39	—	—	—	5,813.39
(8) Grant from World Wild Life Fund for the publication of a booklet on conservation	3,024.58	—	—	3,024.58	—	—	—	3,024.58
(9) Grant from Fauna Preservation Society, London for Leopard survey project	97.38	—	—	97.38	52.92	—	52.92	44.46
(10) Scholarship fund under Dr. Sálim Ali-Loke Wantho Ornithological Research Fund Investments	15,374.91	21,444.68	—	36,819.59	25,209.07	—	25,209.07	11,610.52
Carried forward	2,67,752.96	24,037.28	—	2,91,790.24	27,721.06	—	27,721.06	2,64,069.18

SCHEDULE 'A' (Contd.)

Name of the Fund/Grant (1)	*Balance as per last Balance Sheet* (2)	*Additions/ Amounts received during the year* (3)	*Transfers from other Funds* (4)	*Total of columns 2, 3, & 4* (5)	*Spent/ refunded during the year* (6)	*Transfers to other Funds* (7)	*Total of columns 6 & 7* (8)	*Balance as at 31st December 1975 (5 minus 8)* (9)
Brought forward	2,67,752.96	24,037.28	—	2,91,790.24	27,721.06	—	27,721.06	2,64,069.18
(11) Dr. Sálim Ali's 75th Birthday fund	12,595.76	—	—	12,595.76	—	—	—	12,595.76
(12) Grant Govt. of India, Ministry of Science & Technology for Plan expenditure 1974-75, 1975-76	30,983.26	—	—	30,983.26	30,983.26	—	30,983.26	—
(13) Grant Govt. of India, Ministry of Science & Technology, Dept. of Science for publication under Plan expenditure for 1975-76	—	40,000.00	—	40,000.00	3,325.74	—	3,325.74	36,674.26
(14) Grant from Kansas University for study collections	55.18	—	—	55.18	55.18	—	55.18	—
(15) Grant from Bodega Bay Institute of Pollution Ecology for DDT pollution study	2,030.26	—	—	2,030.26	697.90	—	697.90	1,332.36
(16) Director of Archives, Tamilnadu for Pudukkottai bird survey	—	3,000.00	—	3,000.00	2,984.70	—	2,984.70	15.30
(17) Sir Pirojsha Godrej Fund	—	10,000.00	—	10,000.00	—	—	—	10,000.00
(18) Grant from Divisional Forest Officer, Eastern Assam Wild Life Division, Bokakhat for bird ringing project at Kaziranga	—	1,500.00	—	1,500.00	1,500.00	—	1,500.00	—
(19) *Grants from Government of Maharashtra*:								
1. *Grant for* 1974-75:								
(a) Establishment Expenses	12,772.12	—	—	12,772.12	12,772.12	—	12,772.12	—
(b) Building Maintenance	375.49	—	—	375.49	375.49	—	375.49	—
2. *Grant for* 1975-76:								
(a) Establishment Expenses	—	62,229.80	—	62,229.80	45,237.27	—	45,237.27	16,992.53
(b) Building Maintenance	—	6,000.00	—	6,000.00	5,673.62	—	5,673.62	326.38
Total	3,26,565.03	1,46,767.08	—	4,73,332.11	1,31,326.34	—	1,31,326.34	3,42,005.77

Sd/- HABIB & CO.,
Chartered Accountants

BOMBAY, 30*th August*, 1976.

Registered No. F. 224 (BOM)

BOMBAY NATURAL HISTORY SOCIETY

THE BOMBAY PUBLIC TRUST ACT, 1950

SCHEDULE [VIDE RULE 17(1)]

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 *DECEMBER*, 1975

EXPENDITURE

To *Expenses in respect of Properties*:		
Rates, taxes and cesses	Nil	
Repairs and maintenance	644.86	
Salaries	Nil	
Depreciation (by way of provisions or adjusted)	Nil	644.86
,, *Building Maintenance Expenses*:		
(As per contra)		
Met out of the Maharashtra Government grant for 1974-75	375.49	
Met out of the Maharashtra Government grant for 1975-76	5,673.62	6,049.11
,, *Establishment Expenses*:		
Salaries including D.A. from Govt. of Maharashtra Grant (As per contra)		
for 1974-75	12,772.12	
for 1975-76	45,237.27	
Salaries including D.A. (Other than above)	83,795.46	
Society's contribution to Staff Provident Fund	3,864.25	
Payment and Provisions for Ex-gratia Payment to retired employees	3,500.00	
Postages	3,313.82	
Printing and stationery	5,336.72	
Advertisement	217.11	
Telephone charges	1,567.34	
Bank charges	955.18	
Carried forward	1,60,559.27	6,693.97

INCOME

By *Rent* (Accrued & Realised)			Nil
,, *Interest* (Accrued & Realised)			
On Securities	3,524.56		
Less: Income Tax deducted at source	523.00	3,001.56	
On fixed deposits	25,718.71		
Less: Income tax deducted at source	1,215.00	24,503.71	27,505.27
,, *Donations*:			
In cash	8,105.00		
In cash for Library books	500.00	8,605.00	
,, *Towards Specific Funds*:			
Charles McCann Vertebrate Zoology field work fund	875.00		
Pirojsha Godrej fund	10,000.00	10,875.00	19,480.00
,, *Grants*:			
(a) *Government of Maharashtra*:			
1. for 1975-76 establishment expenses		62,229.80	
Carried forward		62,229.80	46,985.27

EXPENDITURE

Brought forward		6,693.97
To *Establishment Expenses* (contd.):		
B./f.	1,60,559.27	
Meeting expenses including talks, film shows etc.	1,954.38	
Conveyance and travelling	596.58	
Motor Car charges	630.54	1,63,740.77
„ *Audit Fees*:		1,000.00
To *Amount Written off*:		
(a) Bad debts	362.13	
(b) Loan scholarships	—	
(c) Irrecoverable rent	—	
(d) Other items	—	362.13
„ *Miscellaneous Expenses*:		
General charges	884.27	
Insurance premium	169.95	
Repairs to furniture & equipment	446.10	
Printing of Society's brochures	2,169.67	
Election expenses	2,041.75	5,711.74
„ *Depreciation*:		
On furniture and equipment	9,975.35	
On Motor cars, Motor cycle and Auto cycle	7,340.08	17,315.43
„ *Amount Transferred to Reserve or Specific Funds*:		
1. Grants transferred to relevant funds	1,12,729.80	
2. Donations towards specific funds transferred to relevant accounts in the Balance Sheet	10,875.00	
3. Sale proceeds transferred to Publication fund account (Glimpses of Nature booklet) as per contra	4,991.00	
4. Interest on fixed deposits transferred to respective funds	23,162.28	1,51,758.08
Carried forward		3,46,582.12

INCOME

Brought forward		46,985.27
By *Grants* (contd.): B./f.	62,229.80	
2. for 1975-76 Building maintenance	6,000.00	
3. for Educational activity	4,000.00	
(b) *Government of India*:		
Dept. of Science & Technology		
1. For Journal ptg. expenses 1975-76	20,000.00	
2. For Plan expenditure 1975-76 for publication	40,000.00	
3. *Indian National Science Academy*: for Jaurnal ptg. expenses 1975-76	3,000.00	
Director of Archives, Govt. of Tamil Nadu for survey	3,000.00	
Divisional forest, Kaziranga for bird study	1,500.00	1,39,729.80
„ *Income from Other Sources*:		
Membership subscriptions	30,712.38	
Student membership subscriptions	260.00	
Corporate membership subs.	18,738.42	
Subscribers to Journal (non-members)	13,958.77	
Entrance fees	3,635.00	67,304.57
Carried forward		2,54,019.64

EXPENDITURE		
Brought forward		3,46,582.12
To Expenses on Objects of the Trust:		
(A) *Educational*:		
From respective funds (As per contra)		
(1) Scholarships for field work (out of field work fund)	1,417.50	
(2) Expenses on Leopard Survey Project (out of the grant from Fauna Preservation Society, London)	52.92	
(3) Expenses towards Research Scholarship and other expenses on Ornithological Research (out of scholarship fund under Dr. Sálim Ali-Loke Wantho Ornithological Research fund Investment)	25,209.07	
(4) Expenses on publication of Shri M. Krishnan's book on Ecological survey of India (out of grant from Seth Purushottamdas Thakoredas & Divaliba charitable Trust)	210.00	
(5) Expenses on field staff salaries bird migration study, Library account and study collections (out of grant from Government of India, Dept. of Science & Technology for Plan Expenditure)	30,983.26	
(6) Expenses for study collections (out of the funds received from Kansas University)	55.18	
(7) Expenses on DDT pollution studies (out of the funds received from Bodega Bay Institute of pollution Ecology, U.S.A.)	697.90	
Carried forward	58,625.83	3,46,582.12

INCOME		
Brought forward		2,54,019.64
By Publications & Surplus on Sale of Books		
Journal sales	616.54	
Glimpses of Nature booklets Sales	4,991.00	
	5,607.54	
,, *Surplus on Sale of Books*:		
Book of Indian birds	16,342.90	
Book of Indian Animals	13,750.20	
Identification of poisonous snake charts	215.00	
Other publications	4,113.20	
Nature calendars	20,393.11	60,421.95
,, *Miscellaneous*: Income		
Library fines	82.70	
Fees for the use of Society's transparencies	4,550.00	
Other receipts	3,121.89	
	7,754.59	
,, *Administrative Fees*:		
For handling various project grants during the year debited to respective funds	1,509.05	9,263.64
,, *Transfers*:		
Depreciation on fixed assets transferred to fixed assets fund	17,315.43	
Expenditure on establishment and building maintenance transferred to Govt. of Maharashtra grant (as per contra)	64,058.50	
Expenditure on other specific objects transferred to relevant funds and grants	67,267.84	1,48,641.77
Carried forward		4,72,347.00

EXPENDITURE			
Brought forward			3,46,582.12
To Expenses on Objects of the Trust (contd.): B./f.		58,625.83	
(8) Expenses on publications (met out of grant Government of India, Dept. of Science & Technology for publications)		3,325.74	
(9) Expenses on field studies (met out of Chas. McCann vertebrate Zoology field work fund)		331.57	
(10) Expenses for the bird surveys met out of funds received from Director of Archives, Pudukkottai, Tamil Nadu Government		2,984.70	
		65,767.84	
(11) Expenses for birds ringing project at Kaziranga (out of funds received from Divisional Forest Officer, Eastern Wild Life Division, Bokakhat		1,500.00	
		67,267.84	
(B) Journal expenses (including expenses for the Index printing)		51,010.98	
(C) Nature walk expenses		—	
(D) Pongam valley bird census field trips		301.87	
(E) Other field trips		61.15	
(F) *Library account*:			
Subscription to other societies	1,420.83		
Purchase of books	655.85		
Other library expenses	15.00	2,091.68	
Carried forward		1,20,733.52	3,46,582.12

INCOME	
Brought forward	4,72,347.00
Carried forward	4,72,347.00

Expenditure				Income	
Brought forward			3,46,582.12	Brought forward	4,72,347.00
To Expenses on Objects of the Trust (contd.):					
B./f.		1,20,733.52			
(G) Expenses on field staff salaries, study collections, bird migration, Library etc.	34,859.57				
Less: Government of India grant, Plan expenditure	30,983.26	3,876.31	1,24,609.83		
To Maintenance of Reference Collection			345.30		
Excess of Income over expenditure transferred to Balance Sheet			809.75		
Total			4,72,347.00	Total	4,72,347.00

Sd/- SALIM ALI,
President.
Bombay Natural History Society

Sd/- A. N. D. NANAVATI,
Honorary Secretary.
Bombay Natural History Society

Sd/- C. V. KULKARNI,
Honorary Treasurer.
Bombay Natural History Society

As per our report of even date
Sd/- HABIB & Co.,
Chartered Accountants.

BOMBAY, 30*th* *August*, 1976.

BOMBAY NATURAL HISTORY SOCIETY

NATURE EDUCATION SCHEME

Receipts and payments account for the year ended 31 *December* 1975

RECEIPTS			PAYMENTS	
To *Balance as at* 1*st January*, 1975:			By Salary for Nature Education Organiser	8,754.20
1. With Bombay Natural History Society		252.23	,, Printing and stationery	376.30
2. With Grindlays Bank Ltd., Bombay on Current account		1,889.38	,, General charges	1,082.65
,, *Grant Government of Maharashtra*:			,, Postages	109.65
For the year 1974-75	8,191.60		,, *Balance as at* 31*st December*, 1975:	
For the year 1975-76	9,819.20	18,010.80	1. Cash on hand with Nature Education Organiser	200.00
,, Sales of Nature Study Booklets		228.09	2. With Grindlays Bank Ltd., on Current account	9,877.38
Balance due to Bombay Natural History Society		19.68		
Total		20,400.18	Total	20,400.18

Sd/- SALIM ALI,
President.

Sd/- A. N. D. NANAVATI,
Honorary Secretary.

Sd/- C. V. KULKARNI,
Honorary Treasurer.

Sd/- HABIB & CO.,
Chartered Accountants.

BOMBAY, 30*th August*, 1976.

MINUTES OF THE ANNUAL GENERAL MEETING HELD ON MONDAY 22nd NOVEMBER 1976 AT 6 p.m. AT HORNBILL HOUSE, SHAHID BHAGAT SINGH ROAD, BOMBAY, WITH MR R. E. HAWKINS IN THE CHAIR

The following forty-eight members were present:

1. Mr Dinsha J. Panday
2. Mr Nazir Latif
3. Mr I. G. Valles
4. Dr P. J. Deoras
5. Mr A. A. Dikshit
6. Dr R. N. Vasa
7. Mr Shahid Ali
8. Dr A. N. D. Nanavati
9. Mr G. V. Bedekar
10. Mr H. Abdulali
11. Mr P. Kannan
12. Mr H. K. Divekar
13. Mr Ulhas Rane
14. Mr. J. C. Daniel
15. Mr Lavkumar Khacher
16. Dr P. T. Thomas, Indore
17. Mr R. E. Hawkins
18. Dr S. R. Amladi
19. Mr V. K. Paralkar
20. Dr B. Das Gupta
21. Prof. P. V. Bole
22. Mrs D. E. Aranha
23. Mr John F. Wakefield
24. Mr. A. Hidayatullah
25. Mr M. R. S. Captain
26. Mr G. C. Patel
27. Mr Jagdish Agarwal
28. Mr V. I. Moizuddin
29. Mr Satyendra Yadav
30. Mr Sam J. Bhacka
31. Mr Satish Sabharmal
32. Miss Renee Borges
33. Mrs D. S. Variava
34. Mr Bansi Mehta
35. Mr Chandragupta Bhogilal Mehta
36. Dr C. V. Kulkarni
37. Mr Harish R. Yadav
38. Dr A. K. Joshee
39. Mr S. R. Nayak
40. Smt Mulibai Ratanshi Kapadia
41. Mr M. B. Lukmani
42. Mr S. N. Mistry
43. Mr Anil A. Dave
44. Mr K. K. Vajifdar
45. Mr Himmat Kalsia
46. Mr David Fernandes
47. Mr Ramesh Bhat
48. Mr Krishna Paupamah

At the outset the Chairman expressed the hope that, in view of the substantial Agenda, speeches would be brief and to the point. He recalled that the Society was nearly 100 years old and that the present Rules and Regulations had been drawn up nearly 50 years ago, at a time when the Society had no premises of its own but was housed through the generosity of Messrs Phipson & Co. Ltd., the members of which firm also provided a measure of supervision. When Messrs Phipson were no longer able to house us, the Government of Maharashtra made temporary accommodation, larger than we had previously occupied, available to us off Walkeshwar Road. We are now housed in a handsome building of our own, by courtesy of the trustees of the Prince of Wales Museum and with the sup-

port of the Government of India. Because of such changes, amendment in the Rules became necessary, and the changes were to be considered at this meeting.

Dr P. J. Deoras suggested that the amendments proposed would not sufficiently modernize the Society, or make it comparable with similar societies in other parts of the world. He poposed appointment of a committee to consider the matter afresh. The Chairman in answer stated that the business of today's meeting was to consider the amendments which had been printed and which were the result of long deliberations by a committee appointed to consider such amendments.

The Chairman then called upon the Honorary Secretary to present the Annual Report.

The Annual Report for 1975, copies of which had been supplied previously, was taken as read. The Honorary Secretary further informed members of notable events during the period following the report. The most important event was the award of the Paul Getty Prize for 1975 for Conservation activities to our President, Dr Sálim Ali. He further inforfed the house that Dr Sálim Ali had expressed a desire to donate Rs 3.5 lakhs to the Society as a Nature Conservation Fund to encourage Conservation, Research studies and educational activities. The objectives and terms for utilization of this Fund were being worked out by a sub-committees. In the meantime, Dr Sálim Ali had undertaken to defray the cost of publishing a Newsletter, and we have revived *Hornbill*, the first issue of which will shortly be distributed to members.

Among other important events and activities he mentioned the Nature Camp at Bharatpur which had been greatly appreciated by all members, the survey, and projected field guide to Sriharikota Island, and the further donation of Rs 10,000/- (bringing the total to Rs 20,000/-) from the Pirojsha Godrej Foundation.

The Chairman invited questions on the report.

Mr Humayun Abdulali wished to know who represented the Society on the IBWL, State Wildlife Board, IUCN and ICBP, and how many meetings of each they had attended. The Honorary Secretary stated that he represented the Society on the first two bodies and had attended every meeting except the last one early this month. Dr Sálim Ali represented us on the two International bodies; the number of meetings attended would have to be ascertained.

Mr Abdulali complained that Dr Grubh's thesis was not available in the Society's Library. The Honorary Secretary undertook to see that one copy was placed in the Library.

Mr Abdulali recalled that the Fauna volume of the Maharashtra Gazetteer, matter for which had been supplied by the Bombay Natural History Society had been full of mistakes and hoped that such unfortunate mistakes should not be repeated in the Tamil Nadu Gazetteer.

The Honorary Secretary replied that while we were helping to collect data and would perhaps prepare a write-up, the Society had no editorial responsibility in respect of the Tamil Nadu Gazetteer.

The Annual Report was then approved by show of hands.

The Chairman called upon the Honorary Treasurer to present the Balance Sheet and Statement of Accounts.

Mr A. A. Dikshit asked why election expenses were so much higher than last year. He was informed that this would be checked and the items shown to him.

The Balance Sheet and Statement of Accounts were approved by show of hands.

The Chairman then said that, in accordance with the Society's Rules, item 4 on the Agenda (elections) would have to be considered before item 3 (amendments). He stated that in addition to the ten members proposed by the Executive Committee, whose names were printed on the reverse of the Agenda paper, Mr Abdulali's name had been proposed by Mr Sadiq A. Futehally and seconded by Dr P. J. Deoras, so that an election by postal ballot would be necessary.

Mr Abdulali suggested that an election by postal ballot might not be necessary, as he believed at least one of the members proposed by the Executive Committee was disqualified as he had not paid his subscription for the year on the day of his nomination. Mr Dikshit added that the Societies Registration Act required that a member should have paid his subscription three months prior to the date of the election. Mr Captain supported Mr Dikshit's contention. The Chairman undertook to inquire into the matter.

Consideration of the amendments proposed to the Rules and Regulations was then begun. The Chairman proposed the addition of Rule 64, enabling changes to be made in the Rules, and after some discussion the addition was approved by a majority of 35 for and 8 against.

The Chairman then proposed the adoption of the following resolution validating changes introduced in the past:

> 'Resolved by the General Body of the Society that all additions, deletions and alterations made in the past, to the Rules and Regulations of the Society are valid and shall be deemed always to have been valid from the date of their being approved by the General Body of the Society, and all the acts of the Committee under the powers given to it under Rule 31 of the Rules and Regulations of the Society, from the date of resolution of the Committee as having been authorised by the General Body of the Society.'

Mr M. R. S. Captain proposed the substitution of the words *original approval* for *being approved*. His proposal was seconded by Mr Dikshit and approved by show of hands. The amended resolution was then approved without opposition, namely:

> 'Resolved by the General Body of the Society that all additions, deletions and alterations made in the past, to the Rules and Regulations of the Society are valid and shall be deemed always to have been valid from the date of their original approval by the General Body of the Society, and all the acts of the Committee under the powers given to it under Rule 31 of the Rules and Regulations of the Society, from the date of resolution of the Committee as having been authorised by the General Body of the Society.'

The meeting then proceeded to clause-by-clause consideration of the proposed amendments as printed. All amendments were proposed by the Honorary Secretary and seconded by the Honorary Treasurer.

Clause 1. Mr Captain proposed and Mr Dikshit seconded, that paragraph 2 should read:

> There shall be six classes of members—Life Members, Ordinary Members, Corporate Members, Honorary Members, Student Members and Forest Department nominees. Student members and Forest Department nominees shall not be entitled to vote.

The amendment was put to vote and negatived by 23 to 14. The amendment as printed was put to vote and carried by 24 to 9.

Clause 5. Approved by the show of hands.
Clause 6. ditto
Clause 6A. ditto

Clause 6B. ditto
Clause 7. ditto
Clause 11. Mr Abdulali opined that no change in the existing rule was required. When put to vote however the amendment was carried by a majority of 22 to 4.
Clause 16. Mr. Captain proposed and Mr G. V. Bedekar seconded the insertion in line 4 of *a member of* before 'the Committee'. The amendment was approved and carried with this change.
Clause 16A. Mr Captain proposed and Mr Bedekar seconded the insertion of the word *prior* before 'approval', in line 3. The amendment was approved and carried.
Clause 18. Mr Captain proposed that the existing Rule should be kept with the addition of the words:

> Provided that before passing the resolution to expel the member the Committee shall give one month's notice of the proposed expulsion to the member and call for an explanation why he should not be expelled.

after the word *Society* in line 2 on p. 5.
The proposal was defeated by 22 voting against and 10 for. The amendment as printed was put to vote and carried by 22 to 8.
Clause 19. The Honorary Secretary proposed and Mr Abdulali seconded the addition of the words *the collections or to* in line 5 of the Proposed Amendments (p. 5) between 'visitors to' and 'any meeting'. His suggestion was accepted and the amended version approved by show of hands.
Clause 20. Approved by show of hands.
Clause 26. Mr. Captain pointed out that the business of an Annual General Meeting should include the appointment of auditors. He proposed the addition of

> (*c*) The appointment of auditors and the fixing of their remuneration.

In consequence the amendment as proposed would become (*d*) instead of (*c*), and (*d*) would be (*e*). His proposal was seconded by Mr Nanavati. The addition of a new clause (*c*), with consequential changes, was approved, as well as the proposed addition to existing clause (*c*).
Clause 31. Mrs D. S. Variava proposed and Mr Captain seconded that the words *in Greater Bombay* in lines 5-6 (p. 6) be changed to *within* 200 *km* of Bombay. This amendment was carried by show of hands.

Mr Captain proposed and Mr Abdulali seconded that there should be 6 *ex-officio* members and 10 ordinary members as in the old rule. The proposal was defeated by 15 votes to 3, and the printed amendment carried by a show of hands.

As the time was then nearly 9 p.m. the Chairman adjourned the meeting until 6 p.m. on the following day (Tuesday, 23 November).

Continuation of Minutes. Adjourned meeting reconvened at 6 p.m. on 23rd November 1976.

Twenty-six members were present:

1. Mr Humayun Abdulali
2. Mr M. R. S. Captain
3. Mr A. A. Dikshit
4. Mr Ulhas Rane
5. Mr J. C. Daniel
6. Mr P. Kannan
7. Mr G. V. Bedekar
8. Dr C. V. Kulkarni
9. Prof. P. V. Bole
10. Dr S. R. Amladi
11. Mr Bansi Mehta
12. Mr R. E. Hawkins
13. Mr Lavkumar Khacher
14. Mr Dinsha J. Panday
15. Dr A. N. D. Nanavati
16. Mr S. R. Nayak

17. Mr H. K. Divekar
18. Mr M. K. Patel
19. Mrs D. S. Variava
20. Mr Chandragupta Bhogilal Mehta
21. Mr S. N. Mistry
22. Mr Ramesh Bhat
23. Mr I. G. Valles
24. Mr K. K. Vajifdar
25. Mrs Mulibai Ratanshi Kapadia
26. Mr K. Paupamah

In response to a question concerning the elections which had taken place yesterday, the Chairman stated that the *ex-officio* members nominated by the Committee, whose names were printed on the reverse of the Agenda, namely:

Dr Sálim Ali, *President*

Mr R. E. Hawkins, Mr G. V. Bedekar } *Vice-Presidents*

Dr A. N. D. Nanavati, *Hon. Secretary*

Dr C. V. Kulkarni, *Hon. Treasurer*

were deemed to have been accepted by the meeting and that whatever a postal ballot for the other ten members of the Committee would be necessary or not was to be investigated. If Mr Dikshit's contention that the Societies Registration Act requires a candidate to have paid his subscription three months before the date of his election is valid, and if it is then found one or more of the members whose names have been proposed by the Executive Committee had not paid their subscription three months before the date of election he would be disqualified. Not more than ten members would then have been proposed for membership of the Committee and all would be deemed to have been elected. If however Mr Dikshit's contention is not upheld, an election by postal ballot will be necessary.

Clause-by-clause consideration of the proposed Amendments was then resumed.

Clause 31. After discussion, the printed amendment was approved by a majority of 22 to 0.

Clause 32. The Chairman suggested there had been a typographical error in line 3 from the end and that the words /*in the separate space provided*/ should read /*in the separable portion provided*/. With this change the amendment was carried without opposition.

Clause 32A. Approved by show of hands, with only one dissentient.

Clause 33. Approved by show of hands, with no dissentient.

Clause 34. On the proposal of Mr Captain, seconded by Mr Bedekar, the words *Subject to Rule* 32A, were to be inserted at the beginning of the clause, and in lines 3 and 2 from the end of the words 'an *ex-officio*' were to be substituted for 'a nominated', so that the final words would read '...and if he is an *ex-officio* member shall hold office till the next nomination of *ex-officio* members'. With these changes the amendment was approved by show of hands.

Clause 35. Mr Captain proposed, seconded by Mr Dikshit, that the clause be deleted as being no longer relevant. When put to vote, 13 members were in favour of retaining the clause and 6 against.

Clause 43. Approved by show of hands.

Clause 44. Mr Captain contended that no addition to the existing rule was necessary, or that if the addition was made the words *subject to ratification by the next meeting of the General Body* should also be added. After several other amendments had been considered it was decided to delete the words *on all members, when applicable* so that the addi-

tion will read: 'All such Bye-Laws, until revoked or altered, shall be binding as if they were contained in these Rules and Regulations.' This was approved by 18 votes to 3.

Clause 45. Mr Captain suggested that the order of words at the end should be 'shall not be entitled to vote at the meeting' instead of 'at the meeting shall not be entitled to vote'. With this modification the amendment was approved by show of hands.

Clause 53. Approved by show of hands.

Clause 55. The propriety of the opening phrase 'The Honorary Treasurer or his deputy', which appears in the 1928 Rules, was questioned by several speakers, but when put to vote the amendment as printed was approved by 20 to 0 by show of hands.

Clause 57. Approved by show of hands.

Clause 60. Approved by show of hands, with three dissentients.

Clause 61. Approved by show of hands, with three dissentients.

Clause 64. Already approved at the beginning of the meeting.

Clause 65. It was suggested that this clause was unnecessary because the procedure for dissolution is governed by the Societies Registration Act. Mr Abdulali also pointed out that account had not been taken of commitments entered into at the time of receiving the building grant from the Government of India. It was therefore decided by show of hands not to add this clause, or Clause 66 which is related to it.

Clause 67 (which will now be 65). Approved by show of hands.

Clause 68 (now 66). Two amendments were proposed, the first, proposed by Mr Captain and seconded by Mr Abdulali, suggested the substitution of the words *binding subject to confirmation in a General Meeting* instead of the last word *final*. The other amendment, proposed by Mr Divekar and seconded by Mr Captain, was that the words *binding unless overruled at a General Meeting* be substituted. The first amendment was rejected by 4 to 15, the second approved by 15 to 6. With the second amendment the clause was approved by show of hands.

The business of item 4 of the Agenda having been concluded, the meeting proceeded to the appointment of auditors. The Honorary Secretary indicated that Messrs Habib & Co. had kindly agreed to act at a fee of Rs 1,000|- and proposed that their appointment be approved. The meeting approved this appointment.

The Chairman then called upon Mr Dikshit to move the resolution of which he had given notice. Mr Dikshit then proposed the following resolution:

> Resolved than an Enquiry Committee be constituted to thoroughly investigate the reference made by the Second Enquiry, headed by Mr Wagle, to certain activities instigated by somebody against Mr Humayun Abdulali and prompt and stern action taken on that Committee's recommendations.

Mr Dikshit gave his reasons at length and was seconded by Mr Abdulali. Several other members spoke. In reply the Chairman pointed out that an Inquiry Committee had been appointed, of which he had himself been a member, and that the activities referred to in the Resolution had been included in its terms of reference. In this connection the Inquiry Committee had used the words 'an aberration, possibly instigated' and had not recommended any further action. The resolution was rejected by 18 votes to 3.

Mr Bansi Mehta, who had also given notice of a resolution, said that he desired to withdraw it.

The Agenda having been completed, the Chairman closed the meeting at 8.15 p.m.

The meeting terminated with a vote of thanks to the Chair.

EXECUTIVE COMMITTEE

President

Dr Sálim Ali, D.SC., F.N.A.

Vice-Presidents

Mr R. E. Hawkins
Mr G. V. Bedekar, I.C.S. (Retd.)

Hon. Secretary

Mr A. N. D. Nanavati, M.D.

Hon. Treasurer

Dr C. V. Kulkarni, M.SC., Ph.D.

Member

Secretary, Dept. of Science & Technology, Government of India

ADVISORY COMMITTEE

Mr H. G. Acharya	*Ahmedabad*
Mr F. C. Badhwar, O.B.E.	*New Delhi*
Dr B. Biswas	*Calcutta*
Mr S. Chaudhuri	*New Delhi*
Dr Chintaman Deshmukh, I.C.S. (Retd.)	*Hyderabad*
Mr Zafar Futehally	*Bangalore*
Mr Shivrajkumar Khachar	*Jasdan*
Mr M. Krishnan	*Madras*
Mr Duleep Matthai	*New Delhi*
Mr N. D. Jayal	*New Delhi*

At the Annual General Meeting held on 23 November 1976 it was suggested that one of the ten Gentlemen nominated for membership of the Executive Committee was disqualified on account of his subscription having been in arrears for a period of more than three months. Only one other Gentleman had been proposed for election, and a Committee of ten was to be elected.

Learned Counsel has now expressed the opinion that the objection raised was valid, and therefore the following Gentlemen are declared elected to the Executive Committee for the year 1976-77:

Mr Humayun Abdulali
Dr S. R. Amladi
Prof. P. V. Bole
Dr B. Dasgupta
Mr H. K. Divekar
Mr Lavkumar J. Khacher
Mr Nazir Latif
Mr Bansi Mehta
Mr S. V. Nilakanta
Mr D. J. Panday

THE SOCIETY'S PUBLICATIONS

Mammals

The Book of Indian Animals, by S. H. Prater. 4th edition (Reprint). 28 plates in colour by Paul Barruel and many other monochrome illustrations. (*in Press*)

India's Wildlife in 1959-70, by M. Krishnan. With 242 photographs. Rs. 35
(*Price to members Rs.* 30)

The Ecology of the Lesser Bandicoot Rat in Calcutta, by James Juan Spillett. Rs. 10

Birds

The Book of Indian Birds, by Sálim Ali. 10th (revised) edition. 70 coloured and many monochrome plates. Rs. 45
(*Price to members Rs.* 40)

Checklist of the Birds of Maharashtra, by Humayun Abdulali. Rs. 2.50
(*Price to members Rs.* 2)

Snakes

Identification of Poisonous Snakes. Wall chart in English, Gujarati, and Marathi. Rs. 5

Plants

Some Beautiful Indian Trees, by Blatter and Millard. With many coloured and monochrome plates. 3rd edition (Reprint). Rs. 40.00
(*Price to members* Rs. 35)

Some Beautiful Indian Climbers and Shrubs, by Bor and Raizada. With many coloured and monochrome plates. 2nd edition. (*in Press*)

Miscellaneous

Glimpses of Nature Series Booklets:

1. OUR BIRDS I (with 8 coloured plates) in Hindi, and Marathi, Rs. 0.80; Kannada. Rs. 0.62
2. OUR BIRDS II (with 8 coloured plates) in Hindi. Rs. 0.62
3. OUR BEAUTIFUL TREES (with 8 coloured plates) in Hindi & Marathi Rs. 0.62
4. OUR MONSOON PLANTS (with 8 coloured plates) in English, Gujarati, Hindi and Marathi. Rs. 0.80
5. OUR ANIMALS (with 8 coloured plates) in English, Gujarati, Hindi, and Marathi. Rs. 1.25

Glimpses of Nature in India (with 40 coloured plates) in English Rs. 7.50
(*Price to members Rs.* 5)

Back numbers of the Society's Journal. Rates on application.

The Society will gratefully accept back numbers of the *Journal* from members who may not wish to preserve them.

TERMS OF MEMBERSHIP

Entrance Fees:

Ordinary and Life Members	Rs. 25
Forest Department Nominees	—
Student Members	Rs. 10

Subscription:

(*a*) Ordinary individual Members	Rs. 50
(*b*) Ordinary Corporate Members	Rs. 100
(*c*) Ordinary Members resident outside India	Rs. 85
Life Members	Rs. 750 (Rs. 250 after 20 years)
Compound Corporate Members	Rs 1000
Forest Department Nominees	Rs. 36
Student Members (without Journal)	Rs. 10
Annual subscription to Journal	Rs. 90

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